# NAVAL POSTGRADUATE SCHOOL
## Monterey, California

# THESIS

A MODEL OF THE DOMESTIC COMMERCIAL SATELLITE INDUSTRY: A DIFFERENT PERSPECTIVE

by

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March 1981

Thesis Advisor: D. G. Boger

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The domestic satellite (DOMSAT) industry has progressed through many stages of development in its short history. These stages of development are based on the areas of influence that deeply effect the direction of the industry. Based on the author's model of industry structure, conduct and performance, a model of the telecommunications industry past and present is developed. The stages of the telecommunications industry are based on the

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premise that various external environmental factors played a key role in influencing the industry as it progressed over time. Satellite communications technology has its base in the telecommunications industry and thus follow a similar pattern of development through four major stages of growth that impact the DOMSAT industry structure, conduct and performance.

# A Model of the Domestic Commercial Satellite Industry: A Different Perspective

by

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# I. INTRODUCTION

> A communications satellite is a very simple concept, but simple concepts sometimes change the world.
>
> James Martin
> Communications Satellite Systems

Domestic satellite communications is a fairly new concept in communications development technology. Less than 25 years old, satellites have made a tremendous impact on our lives. Even more so than the telephone and telegraph, satellite communications has brought closer together not only our society but also the world as well. Communications, whether it be voice, data or facsimile, can bring the most distant of places out of isolation through the use of satellites.

Because of the rapid advancement of satellite technology, the satellite communications industry has experienced many growing pains in its development. In its short life, the domestic satellite industry has gone through several stages of historical development. This thesis presents the development of the domestic satellite industry from the perspective of the technology and the external environmental factors that shaped and molded the domestic satellite industry of today.

To better understand the importance placed on technology and the industry's external environment, Chapter II develops the author's model of an industry's structure, conduct and performance that will be the basis for examining the domestic satellite industry. Since the technology of satellite

communications had its background in the telecommunications industry, Chapter III describes the evolution of the telecommunications industry through four stages. The stages are based on a cyclical pattern of prominent external environmental factors that dominated the industry's growth. Chapter IV outlines the historical progress of satellite communications technology both in the commercial and military environment. This sets the stage for Chapter V. Chapter V traces the progression of the domestic commercial satellite industry based on the model of the industry structure, conduct and performance. The DOMSAT industry also shows a similar cyclical pattern of major influences that impacted the telecommunications industry. The final stage of the DOMSAT industry looks at some of the factors that will affect the application of satellite communications in the future--the technology transfer of satellite communications to public service users and the introduction of the direct broadcast satellite concept.

Satellite communications is still in its infancy. The potential for a variety of satellite technology applications for both private and business uses appears unlimited. However, the direction that domestic satellite communications will take in the future and its effects on society will depend upon the elements that surround the industry and the forces that seek to control the external environment of the industry.

## II. INDUSTRY STRUCTURE, CONDUCT AND PERFORMANCE: A MODEL

In the complex world of the twentieth century, interactions between people and the environment transcend almost every aspect of day to day living. As a result of progress and technological changes, organizations over the centuries have evolved from simple structures to very complex systems containing hundreds of variables. In the study of economics, the industrial organization is one such system of interactions--interactions between markets and industry.

Economists approach the study of industrial organization through the analysis of three major concepts: industry structure, conduct and performance. Thumbing through various textbooks, it's clear that there is agreement on this approach but disagreement on the cause-effect relationship among the three elements. What influences performance more, structure or the industry's conduct? Does conduct effect structure? This chapter deals with the discussion of industry structure, conduct and performance. Also dealt with in this chapter is the concept of industry strategy, an important factor in the discussion of industry structure.

### A. INDUSTRY STRUCTURE

Any discussion of industry structure must first be prefaced by an understanding of a broader term, market structure. By definition a market is a "closely interrelated group of sellers

and buyers" and a market structure refers to those characteristics of an organization of a market that seem to exercise a strategic influence on the nature of competition and pricing within the market" [1]. The three basic elements of market structure are:

1. Buyer/seller concentration
2. Product differentiation
3. Barriers to entry

Buyer/seller concentration simply refers to the number and size distribution of buyers/sellers in the market [2]. Monopolies (one seller), oligopolies ( a few sellers) and atomistic (many sellers) industries are examples of the varying degrees of seller concentration that can be found in the marketplace.

Product differentiation is viewed as the extent to which outputs (though similar) by various sellers in the market are viewed as nonidentical by the buyers [3]. The most common method of product differentiation today is the use of "brand" names. The amount of money spent by companies in advertising in an attempt to sway you over to their product is staggering. The companies that produce "brand" name breakfast cereals are a classic example. Walk down any supermarket aisle in America today and one is undoubtedly faced with an aisel full of various breakfast cereals from which to choose. There are wheat chex and corn chex, sugar-coated and fruit-flavored cereals, cereals in the shape of circles and others shaped like stars, nutritious cereals that "kids like" and, of course, the cereal that is the "breakfast of champions!" Although all cereals are generally

alike, the amount of differentiation between these products and the resulting consumer demand of one over the other influences the competitive relationship between firms as well as their conduct and performance in the industry.

Barriers to entry refers to "the relative ease or difficulty with which new sellers may enter the market, as determined generally by the advantages which established sellers have over potential entrants" [4]. The easier it is for a new firm to enter the market, the more competitive is the industry. Likewise, the more difficult the entry, the less competitive the market. Since the degree of entry is based on the "competitive" price of a product, entry can be measured "by the highest price which will just fail to tempt new firms into the industry" [5].

From this broad base of the market, the focus narrows in on the industry. The "market" consists of many industries of various types and sizes, an industry being defined as a "group of sellers potentially in more or less direct competition with each other." Thus the concepts of market structure and structure of an industry are very closely related [6]. With these definitions as a tool, a model of the industry structure can now be formulated.

Figure 1 shows the author's working model of the market and industry structure. In analyzing any organizaion (and an industry is an organization), it is crucial not only to understand the actual make-up of the "structure" in determining conduct and performance, but also to be aware of what major

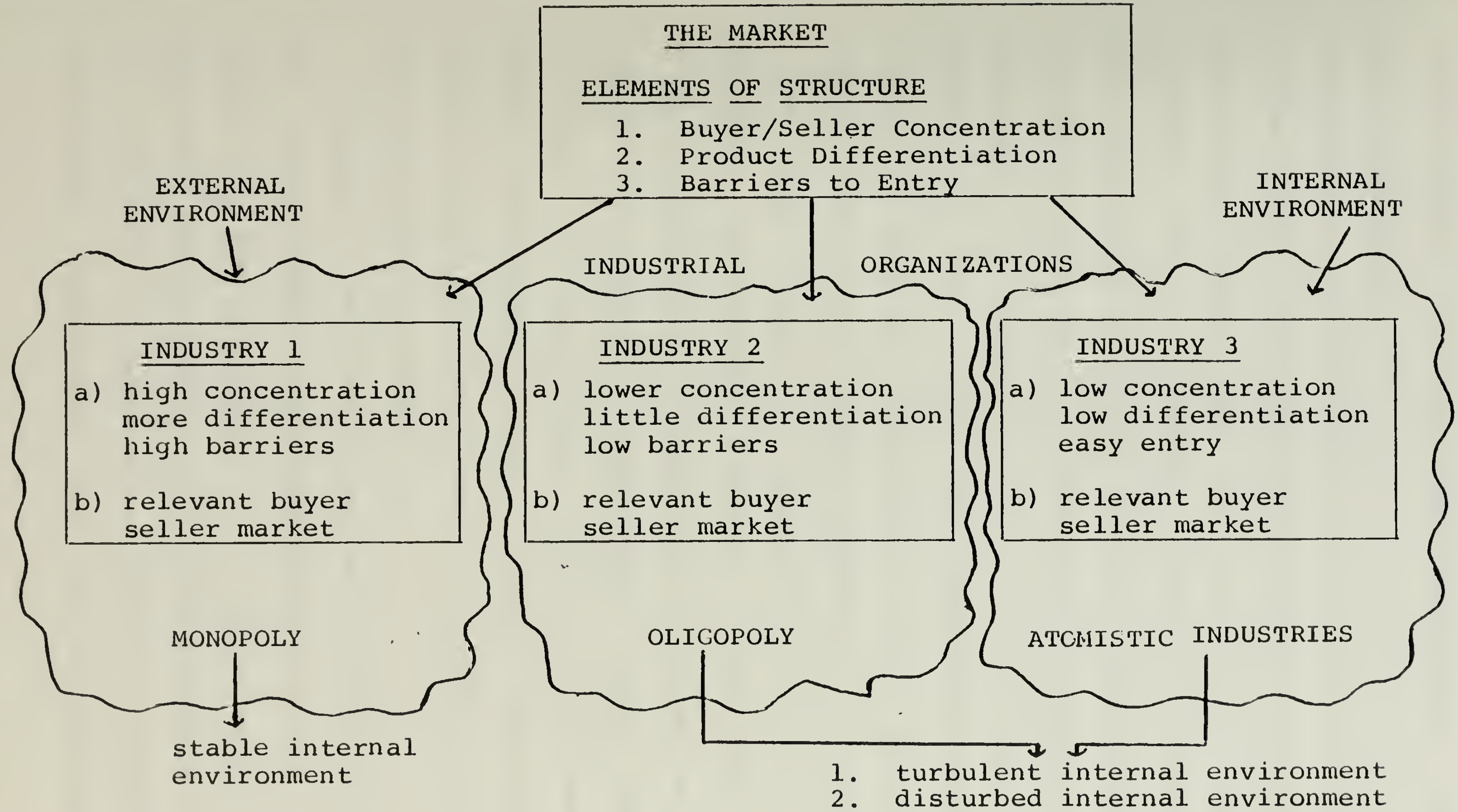



Figure 1. MODEL OF MARKET AND INDUSTRY STRUCTURE

forces lie outside and immediately surround the structure. Richard Caves, in his book American Industry: Structure, Conduct, Performance, uses the terms structure and environment synonymously. In the author's model however, structure refers to some organizational characteristics while environment connotes various forces which have an effect and impact on the structure. In the industrial organization framework, environment consists of two parts: internal and external. It is the structure of the industry (the degree of buyer and seller concentration, the extent of product differentiation and the various barriers to entry) that shapes the internal environment (a state of behavior, if you will) of an industry while the external environment directly impacts on the structure.

The basic elements of the market structure are the same elements in the industry structure. The degree to which firms in an industry exhibit these elements shape the internal environment of an industry. Consequently, we can categorize various industries not only by their outputs or services, but by their internal environment as well. Figure 1 shows various types of industry internal environments to include monopolies, oligopolies and atomistic industries.

Industry 1 exhibits monopolistic behavior and is surrounded by a stable internal environment which is slow to change and offers very few surprises [7]. An industry where there is a high buyer concentration level, high product differentiation and relatively high barriers to entry is a product of this environment. Industries 2 and 3 are oligopolies and atomistic

industries respectively. These industries could either be in a turbulent or disturbed environment. Industries in a turbulent environment are dynamic and rapidly changing and must continually reevaluate their relationship vis-a-vis governmental agencies, competitors, customers etc., while in a disturbed environment industries tend to hinder opportunities of its competitors [8]. An industry which exhibits low concentration, low product differentiation and easy entry into the market as elements, has all the flavor of this kind of environment. A fierce dog-eat-dog competition exists, if you will.

Two factors that have a major impact on structure are technology and the external environment. The reason for separating technology from the external environment is that technology may come from within the internal environment of the industry or directly from another industry. The external environment includes the laws, regulations, resources, geographic considerations, other industries or any unpredictable forces, etc., that have a direct bearing on the industry. The boundary layer surrounding the industry's internal environment is flexible and undefined for a reason. Through survival instincts, each firm in an industry, as well as the industry as a whole, tries to shape the environment that surrounds them, or at least attempts to control it. Firms and industries attempt to cope with this external environment by extending the boundary layer through various corporate actions. Such options include:

1. Diversification--diversifing into other product markets.

2. Vertical Integration--integrating to supply its own raw materials.
3. Multinational--carrying out similar activities in other countries [9].

## B. INDUSTRY CONDUCT

Market conduct refers to "the pattern of behavior that enterprises follow in adapting or adjusting to the markets in which they sell (or buy)" [10]. What then affects the industry's conduct? Since the industry's conduct (or the market conduct within the industry) "consists of a firm's policies towards its product and towards the moves made by its rivals in that market;" conduct is essentially a behavioral reaction resulting from the internal environment of the industry structure [11]. The conduct of a monopoly is certainly different from the conduct of an oligopoly.

When dealing with the nature of industry/market conduct, the discussion falls on three areas of business policy:

1. Policies toward setting prices
2. Policies toward setting the quality of the product
3. Policies aimed at coercing rivals [12].

In a monopoly where the internal environment is fairly stable, the monopolist's primary concern with pricing is to the extent or level of his profit making. With high product differentiation maintained in the stable environment coupled with little or no competition from rivals, the monopolist's conduct becomes almost routine, repetitious and, at times, inflexible in nature.

The attitude is one of security. Without a change in conduct to not only meet the demands of the external environment but also exert influence on the environment, the monopolist could face troubled times ahead. When the FCC's 1968 Carterfone Decision opened the doors to competition in the telecommunications (telephone) industry, AT&T did virtually nothing to change its conduct towards competitors. Consequently, AT&T was shocked at the surprising success by the interconnect companies in this field. Since then, AT&T's conduct has still been slow to change. Unless AT&T's conduct becomes attuned to the rest of the industry, it will face serious problems in the future.

Industry conduct under an oligopoly is of a much more complex nature. A firm in the industry recognizes the importance of its price setting policies on the rest of the industry. There is an immediate reaction by other sellers in the market when one firm changes its prices. This interaction of sellers in an oligopolistic market is called mutual interdependence [13].

In an oligopolistic market, the price setting policies are very sensitive if there is low product differentiation in the industry. Many manufacturing industries are examples of low product differentiation. For instance, there is very little price difference among various industrial manufacturers of cotton goods. If one firm decided to substantially increase his price to his customers, that firm may soon find himself out of business as purchasers will go to another manufacturer of the same (real or perceived) product but at a cheaper price.

The policies towards setting the quality of the product is based on the level of product differentiation in the industry. In the above example, low product differentiation results in a limited product policy by the firm. It is limited in the sense that it will be very similar to the other companies because all the firms have basically the same quality of product. Since the firms in the cotton industry are putting out the same quality product at basically the same price, an individual firm can have a slight edge over the others by emphasizing its service policy. For example, a firm can charge a few pennies more for its product if it has an excellent reputation for ontime delivery service.

The industries that have a high degree of product differentiation have more flexibility in policies towards the quality of their product. The makers of "Palm Beach" men's clothing spend a large part of their budget on advertising the quality of their product. Consequently with their reputation firmly established, the firm can afford to charge a slightly higher price based on its product quality.

The third policy area that affects industry conduct is in policies aimed at coercing rivals. Coercive conduct by a firm can be done in one or both of two ways: "(1) taming, weakening, or eliminating existing business rivals; and (2) raising the barriers to entry to curtail the supply of potential rivals. Coercive conduct for the individual firm makes sense only in oligopolistic situations" [14]. Coercive conduct can be in

the form of predatory price cutting and/or a price squeeze by a vertically integrated firm [15].

The above discussion shows that in an oligopoly where the environment is usually turbulent or disturbed, conduct becomes critical. Similar to a balancing act, one wrong move in their policy decisions towards prices, products or rivals could lead to disaster. Because conduct, especially the pricing policy, is crucial, the oligopolistic approach is joint profit maximization, if possible. The best avenue for accomplishing this type of cooperative action would be for the firms to have an agreement on principle (firms agreeing on a comprehensive plan of action), on details and adherence to the agreement by the firms in the industry [16].

Figure 2 shows the relationship between structure and conduct of an industry. The conduct is primarily effected by the internal environment and indirectly by the structure. The conduct can have some effect on the external environment, i.e., the industry lobbying for more laws, increase or decrease of regulations etc. Conduct can also have an indirect effect on the industry structure.

## C. ORGANIZATIONAL STRATEGY IN AN INDUSTRY

An added dimension to the study of industrial organization is organizational strategy. In the business world of today, one cannot overlook the importance placed on developing various strategies or the implementation of strategic planning concepts. Strategies become just as important for the small business

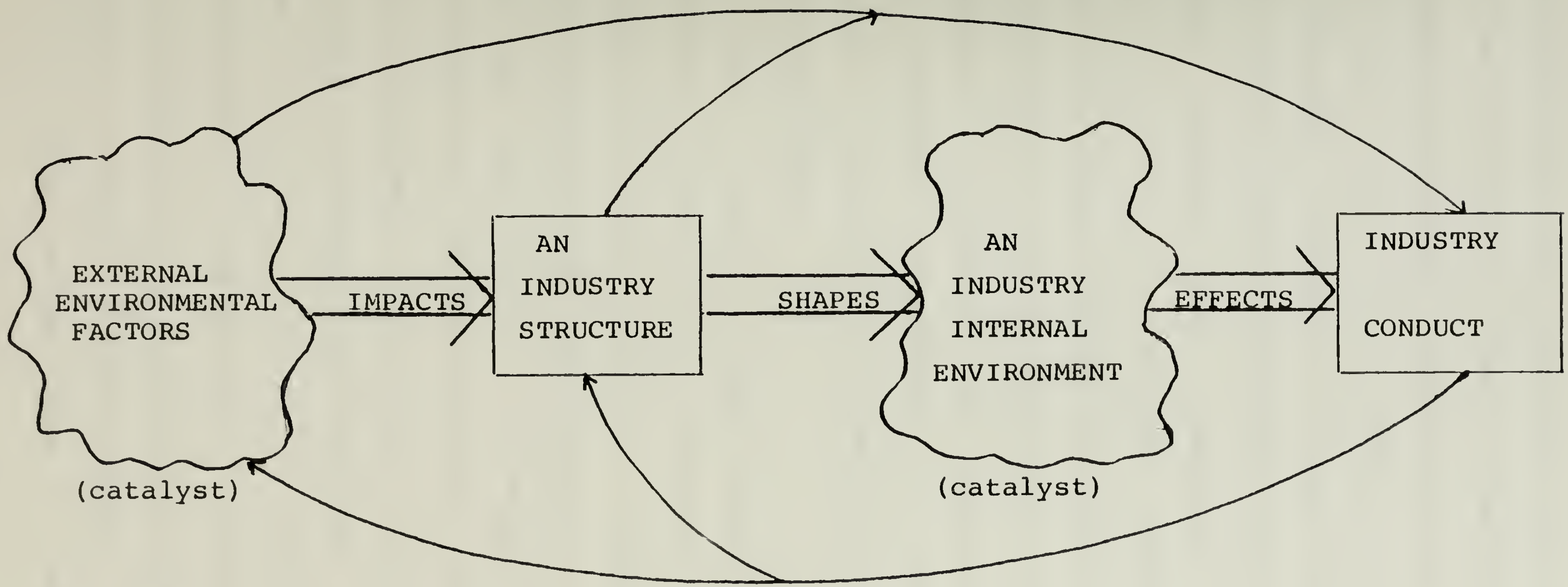



Figure 2. INDUSTRY STRUCTURE AND CONDUCT RELATIONSHIP

firms as they do for the giant corporate structures. This section deals with strategy, strategy formulation and strategy adaptation in today's organization and its importance as a vital part of the industry structure and conduct.

Strategy is critical in today's organizations because of the rapidly changing environment that surrounds each organization. Managers and top executives must develop strategies not only to cope with constant pressures and demands made on them but also must develop strategies for the sake of the organization's survival and future growth. If there were no growth or no direction, the organization would soon stagnate and succumb to its predators. As a familiar statement reflects, "If you don't know where you are going, any road will take you there!"

What is strategy? There are many definitions of strategy depending not only on your frame of reference but also on your perspective as well. Alfred D. Chandler in his book Strategy and Structure states that strategy is "the determination of the basic long term goals and objectives of an enterprise, and the adoption of courses of action and the allocation of resources necessary for carrying out these goals" [17]. Taking a simple straightforward definition, strategy is a plan, a specific plan of action that is chosen to accomplish some goal or objective. What is implicit in these definitions is that strategies/plans are developed because there is a need for change or a need to prevent change. For some organizations, gaining acceptance that there is a need for change (no matter

what the level in the organization) is the hardest battle to win! Once need for change is recognized by the organization, the biggest task is yet to come.

Since businesses and organizations exist in dynamic and everchanging environments instead of a vacuum, they must respond to that environmental change. Strategies in organizations cope with the changes in the external environment by making changes in their internal environment. Essentially then, strategies and strategic planning strive to establish an equilibrium between the environment and the organization. As Figure 3 shows, the struggle to maintain or even reach equilibrium by an organization through strategies is an ongoing battle. Organizations are never in perfect equilibrium; consequently, strategies must constantly be reevaluated to anticipate or react to sudden (or even subtle) changes in the environment. The organization formulates some strategy in an attempt to cope with that environment in either of two ways. First, the firm may try to shape the external environment in some way, or at least try to control it. Firms attempt this by formulating strategies that extend their boundary layer through vertical integration, diversification and multinationals. Second, through the vision of one person or a dominant coalition, an actual or perceived need for change is identified in the organization because of various problems or failure to accomplish an objective or goal. A plan of action is established to make that change and produce a desired outcome. What is overlooked in many firms is that

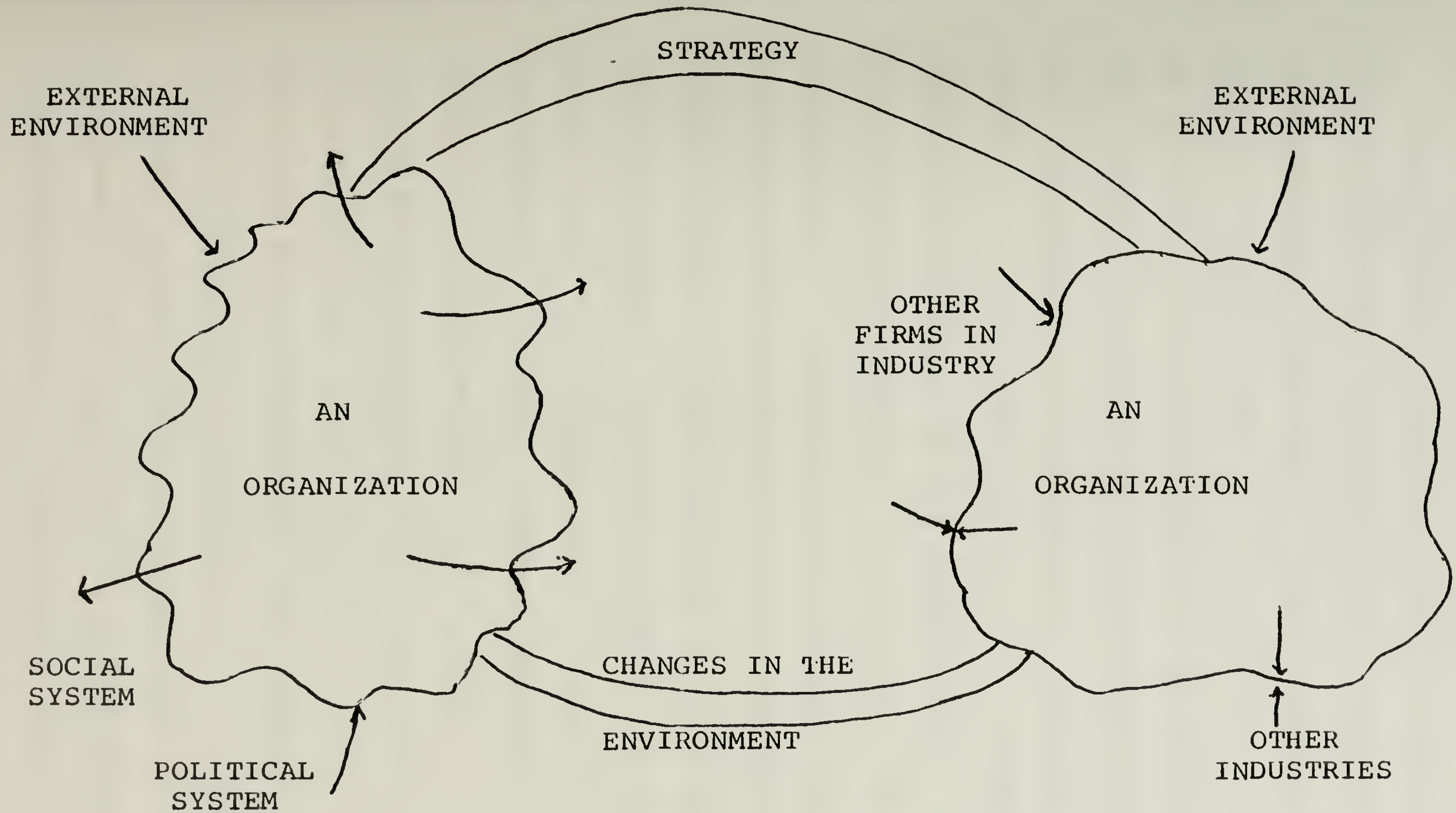



Figure 3. ORGANIZATION AND STRATEGY

the plan of action should also specify what variables in the organization are not to be changed!

Given the above strategy concept, how does the organization move towards the equilibrium state effectively? For many organizations, that's the $64,000 question! Figure 4 illustrates the steps needed in strategy formulation [18]. What is critical in the formulation of any strategy and one of the most common mistakes made by many organizations in their strategy formulation is the failure to understand the "present state" of the organization, i.e., the current structure and operating procedures of the organization. This seems like an easy task--deceptively so. In reality, the various individual perceptions in the organization coupled with attitudes towards, and behaviors related to specific policies and procedures, may reveal a total lack of consensus on just these few basic organizational elements. It would behoove top management to take the time to set the groundwork in this state for proper input into the strategy. The same approach should be taken for future goals, the "where we want to be" state. A specific outline or list of desired outcomes that a firm wants to accomplish should be clearly stated to all concerned. Some organizational diagnosis must be considered for the inputs to be effective. As the old saying goes, "Garbage in . . . garbage out!"

Given a proper starting point, one can specify the exact areas needed for change and the consequences of the change. A common hypothesis of this model is that organizations that

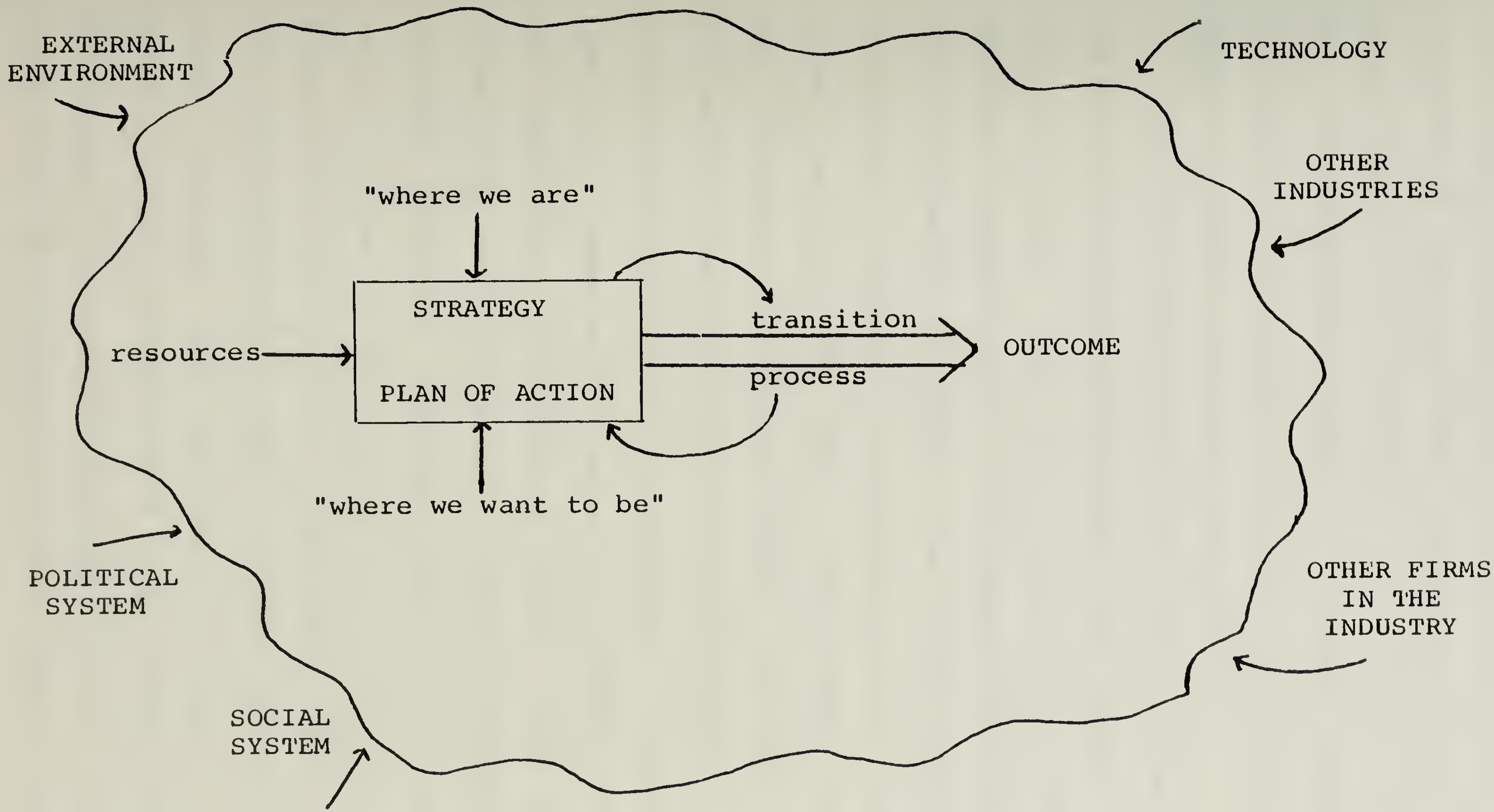



Figure 4. STRATEGY FORMULATION

fail to set up this basic framework can diagnose the problems incorrectly. With the wrong perception of the problems, strategies will be ineffective with confusion as a result. Also, if strategies are based on incorrect assumptions about the external environment, inefficiencies will undoubtedly emerge throughout the entire organization.

Since most strategies involve more than one step to reach the desired outcome, the strategy goes through a transition stage or process. This is the most critical area of the strategy implementation. As an organization moves through the various phases of transition, the strategy should be reassessed to make sure the plan is still moving in the right direction. On many occasions, the steps in the strategy transition period fail to produce the desired results. The cause is usually a misconception about the real problems involved or a confusion of the ends and means of the strategy. A reevaluation of the transition stages with an accurate feedback loop should lead the organization to its desired goals. It is in this transition process that Harry Mintzberg's "unrealized strategy" and "emergent strategy" theory would fall [19]. Once the organization reaches its desired goal/objectives, it now becomes the present state of the firm. The process starts over again. Strategy formulation is then a cyclical evolution. The organization therefore, must continue this cyclical evolution in order to adapt and come into a state of equilibrium with its environment. It must be remembered however that following these steps for strategy formulation does not guarantee success

for an organization. They are merely tools to assist an organization in furthering its goals.

One of the processes of strategy implementation that leads to a successful outcome involves the organization's structure. Chandler's thesis is based on the premise that structure follows strategy. An organization's structure whether it be centralized, decentralized, function or product oriented or multi-divisional in nature, is initially based on the firm's mission objectives and goals. If its objectives are modified and/or changed by some corporate strategy, then a structural change of some sort must take place. One of the reasons why strategies don't work is that a firm tries to "fit" a major organizational change (i.e., changes in policy, objectives, etc.) into an old structure. The key to an organization's long run survival and success lies in its ability to adapt--to adapt not only to those external demands but also to those inevitable internal changes as well.

Turning to the synthesis of strategy and structure, Figure 5 shows the relationship between the organization's strategy and structure and the industry's structure and conduct. An organization in the industry has its own corporate strategy based on the external environment factors which includes worrying about those "other guys" in the industry. Consider the diagram as representative of an oligopoly. The strategy and structure of the firms in the industry would make the industry structure reflect a lower concentration level, little product differentiation and low barriers to entry relative to a

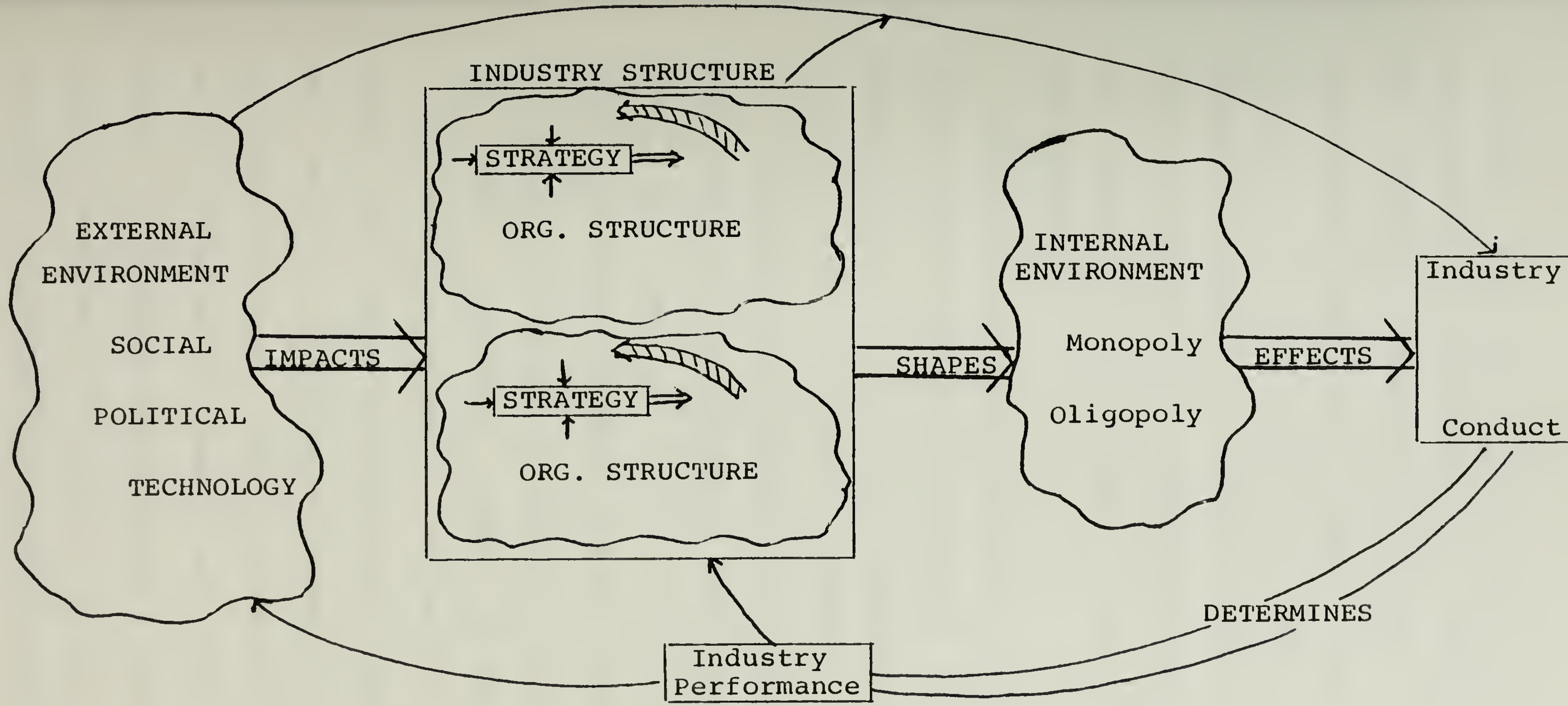



Figure 5. ORGANIZATIONAL STRATEGY AND STRUCTURE WITHIN AN INDUSTRY

monopoly. Thus the industry structure would shape the internal environment of the industry as oligopolistic. In essence then, the industry's internal environment is determined by the strategy and structure of organizations in the industrial structure. In turn, industry conduct is affected. As illustrated by Figure 5, the strategy and structure of an organization coupled with the structure and conduct of the industry, is a dynamic, ever-changing process determined by the various environments.

What has not been discussed so far, is the strategy's effect on the actual structural design in an organization and its relationship (if any) to the internal environment of the industry, i.e., its competitiveness.

Management and organizational theory generally refer to four types of organizational structures: the centralized functional organization, the decentralized multi-dimensional form, the holding company and the matrix organization [20]. A firm in its infancy will start out very highly centralized but loosely structured. Here, the entrepreneur will make most of the decisions himself. As the firm expands, the entrepreneur will begin to lose control due to some crisis and will be forced to implement formal controls with a very centralized structure. This centralized firm however, will still be characterized by power flowing from the top. As this functionally oriented, single product firm matures and grows through successful strategic planning, it will become decentralized. Consequently, decision-making in many key areas

filters down to the lower levels. During this stage of the game, many companies make a drastic change in their structure to reflect a multi-divisional design. This is done as firms begin to diversify into other related or unrelated product areas. Holding companies are essentially multi-divisional in nature but with greater autonomy and authority given at the divisional level. The matrix structure, a fairly new concept, is a combination of both function and product orientation. In today's corporate industries, the trend is towards a divisional form of management. As Chandler points out, as firms get larger over time and diversify, they must decentralize. Therefore, growth via diversification is an excellent corporate strategy approach.

In a big multi-divisional firm, the organizational levels may be divided into three major areas: strategic, coordinative and operating [21]. As companies become more complex, top level management may decide to retain only the strategic decisions (policy formulations etc.) while delegating decision-making relative to actual operations and coordination to the lower levels of the organization. If organizations become geographically dispersed, then divisional managers control most of the operating and coordinative decision-making while strategic planning is still controlled by the dominant coalition in the firm.

How does the structural design of the organization with its characteristic decision-making levels relate to the organization's environmental demands? It was previously

mentioned that the external environment consists of many factors: the political system, the social system, technology, other firms and other industries. These factors may be classified into three general types of environmental demands: stable, regulated flexibility and adaptive [22]. In the stable environment the organization is faced with familiar problems so there is very little need for change. The firm surrounded by a regulated flexible environment is also faced with familiar problems but identifies a frequent need for change. A company surrounded by the adaptive environment is confronted by many constant challenges as it is faced with unprecedented problems and sees a constant need for change.

It has been stated that an organization's strategy determines its structure; and the structure of the firms in the industry shape the industry's internal environment. But is there a direct cause-effect relationship between the firm's structure and the industry's competitiveness? The contingency theory states that "there is no best way of organizing, but that all ways of organizing are not equally effective" [23]. Effectiveness here refers to the degree of economic performance. Studies done by Lawrence and Lorsch showed that "high performing firms in an uncertain environment had greater decentralization than low performers, and that in the predictable industry, the high performer was the more centralized" [24]. Given the relationship between the environment and types of industries that were discussed earlier, the author concludes that firms in an oligopolistic industry tend to perform better with a

decentralized structure, while monopolies tend to be more effective in a centralized structure.

Galbraith and Nathanson conclude after reviewing many studies in this area that "competitiveness affects organizational structure and process. The more a firm is decentralized and formalized in a competitive environment, the stronger the relation with economic performance" [25]. Although the author is in general agreement with the above contention, it is difficult to determine whether industry competitiveness causes certain organizational structures to emerge directly or vice versa. It's the age-old dilemma of deciding, "Which came first? The chicken or the egg?" For example, an oligopolistic industry may cause individual organizations to decentralize their structure, but it may have been the individual firm's long run desires (goal or strategy) to be competitive in the first place. Consequently, it's more appropriate to look at the relationships between industry structure, conduct, performance and organizational strategy and structure in terms of general characteristics or tendencies between them rather than defining (or trying to define) direct cause-effect relationships. Table 1 summarizes these associations.

In conclusion, some general interrelated propositions can be made about industrial organizational analysis:

1. The analysis of the total market structure, conduct and performance parameters is a major planning tool for large diversified corporations in any environment.

TABLE 1

INDUSTRY AND ORGANIZATICN CHARACTERISTICS

| INDUSTRY ORGANIZATIONS | CHARACTERISTICS | |
|---|---|---|
| Industry External Environment | Stable/turbulent | Stable/turbulent |
| Industry Structure consists of: | | |
| 1. Org. Environment Demands | Stable | Regulated Flexible/ Adaptive |
| 2. Org. Strategy | Predictable, Risk Aversion | Flexible, Innovative |
| 3. Org. Structure | Centralized (function) | Decentralized (division) |
| 4. Org. Strategy Adaptation | Few Changes | Frequent changes |
| Industry Internal Environment (Degree of competitiveness) | MONOPOLY Non-competitive Stable internal Environment | OLIGOPOLY Competitive Turbulent Internal Environment |
| Industry Conduct | Routine, Predictable, Repetitious, Inflexible | Critical, Less Predictable, Flexible |
| Industry Performance | More Centralization-Higher Performance | More Decentralization-Higher performance |

2. Norms of industry performance are related to organizational form including structural and behavioral variables.

3. Industry structure is not just based on the strategy and structure of one organization, but on interactions between all the firms in the industry.

4. Environmental factors impact industrial structure and are key inputs to organizational policy formulation. These factors therefore determine the direction of the organizational strategy and ultimately the organizational structure.

5. Organizational strategy in essence is formulated to achieve some desired objective/goal. The success or failure of that organizational strategy relative to the other firms in the industry shapes the internal environment of the industry.

6. Organizational conduct and performance are feedback indicators (measures of effectiveness and efficiency) for an industry.

7. Feedback loops denote an open and very dynamic system with many interrelating variables that constantly interact.

## D. INDUSTRY PERFORMANCE

The first three sections of this chapter discussed the many variables associated with an industry in understanding its structure and conduct and the importance of strategy as a vital part of making an industry or firm successful. But the end result of the market conduct by the various industries is in their market performance. Caves defines market performance "as the appraisal of how far the economic results of an industry's behavior fall short of the best possible contribution it could make to achieving these goals" [26]. But how does one measure an industry's behavior? Bain recommends several criteria for measuring an industry's performance:

1. The relative technical efficiency of production so far as this is influenced by the scale or size of plants and firms (relative to the most efficient), and, by the extent, if any, of excess capacity.

2. The height of selling price relative to the long-run marginal cost of production and to the long-run average cost of production (usually about the same as long-run marginal cost), and the resultant profit margin.

3. The size of industry output relative to the largest attainable consistent with the equality of price and long-run marginal cost.

4. The size of sales-promotion costs relative to the costs of production.

5. The character of the product, or products, including design, level of quality and variety.

6. The rate of progressiveness of the industry in developing both products and techniques of production, relative to rates which are attainable, and also economical in view of the costs of progress. [27]

In any analysis, however, where more than one criterion is used to evaluate a given situation or circumstance, it can become difficult to weight each criterion in terms of the importance, impact or priority. The analysis of the telecommunications industry and the domestic commercial satellite industry performance runs into this difficulty. Because of their relative importance in the telecommunications and domestic satellite industries, a brief discussion will center on two of the above criteria: 1) product performance and technological progress, and 2) technical efficiency. Chapters 3 and 5 will examine in more detail these criteria regarding the telecommunications and domestic satellite industries respectively.

Product performance is "how well the firms engaged design, determine the quality of, vary, differentiate, and progressively improve their products--all relative to that performance in these several regards which would achieve the best attainable balance between buyer satisfaction and the cost of production" [28]. Depending on the internal environment of the industry, the dimensions of product performance may be looked at from different perspectives. In a monopoly, products would be difficult to grade on their quality since there would be essentially no directly comparable standards. Also, the rate of technological progress (progressive improvement) will be slow since there are no challenges from other companies to demonstrate that there is something better to be provided. In an industry that exhibits an oligopolistic environment with a high degree of product differentiation however, product performance must be demonstrated by the various firms in the industry for the very survival of those firms. Through the use of advertising, firms are constantly exposing their product to the public with promises of a "new, improved, better than before" product. Besides being informative, industries use advertising as a means of persuading the general public of the quality of its product. With a high degree of competitiveness and each firm wanting to get the jump on the next guy, technological progress can occur at a rapid pace in an industry. In an industry that exhibits an oligopolistic environment with a low degree of product differentiation, product performance would be difficult to measure.

An industry's market performance in the area of technical efficiency refers to "how closely it approaches (or how far it misses) the goal of supplying whatever output it produces at the minimum attainable unit cost of production" [29]. In a monopolistic environment, determining technical efficiency may be difficult to do. Richard W. Mayo and William W. Wittmann, in their thesis, "The Structure, Conduct and Performance of the United States Telecommunications Industry," state that examining the performance of technical efficiency of the Bell System encounters several problems. Problems of diversification, size and the regulatory climate hinder the analysis of technical efficiency [30]. The degree of technical efficiency by a firm in an oligopolistic environment is directly related to the amount of competition in the industry. A firm in a very competitive environment must attain a very high degree of technical efficiency or find iteself in trouble, both as a viable competitor and with respect to its profit margin.

# III. THE TELECOMMUNICATIONS INDUSTRY: PAST AND PRESENT

> The chief importance of the telephone lies in the ways in which it has affected our lives and the society in which we live. In explaining its effects, however, we must always keep in mind that the power of the telephone is not the power of an idea, a creed or an ideology; it is the power of science and technology to enlarge man's life.
>
> Bjorn Lundvall
> Chairman of the Board
> LM Ericsson Co.
> INTELCOM 1977

The telecommunications industry as we know it today is barely 150 years old. The world has seen such advances in communication technology in that short time span that its accomplishments have only been rivalled by a newer even faster growing industry--the computer industry. In the last few generations, the telephone became an integral part of our lives; so much so, that what used to be a luxury item, affordable only to the rich, became a necessity for us all. It would be "unthinkable" to conduct our daily lives without this "taken-for-granted" form of communications. Mr. Lundvall speaks of the importance of the telephone in society. What the telephone, telegraph and other forms of communications that followed accomplished, was to literally bring the world closer together. From the first use of the telephone and telegraph, our society came out of the dark ages of relative community isolation, to a world where integration of values and cultures from all

corners of the earth would soon become a part of our daily lives. But as the communications industry grew, so did its problems. Throughout these past 150 years, the telecommunications industry has had many faces, from that of a welcome and needed public service to a too powerful monopolistic corporation that had to be broken up. This chapter discusses the telecommunications industry both past and present in terms of the American industry structure and conduct model.

In Chapter II the author attempted to analyze the market structure in terms of a firm's organizational structure and strategy in an industry, and the factors that affect an industry as a whole. To understand the structure of any industry, it was crucial to be keenly aware of the major forces that lie outside and immediately surround the structure. Those forces were technology and the external environment, i.e., the political system, the socio-economic system, other firms in the industry and other industries. It is from this technology and external environment perspective that the basic development of the telecommunications industry will be presented.

The telecommunications industry has essentially progressed through four stages based on the factors that had the most influence in shaping/changing the industry to its present day form. Since history itself follows a cyclical pattern, so too does the history of the telecommunications industry. Figure 6 shows the relationship of that cycle to relative timeframes of the industry. Figure 7 shows the development of the

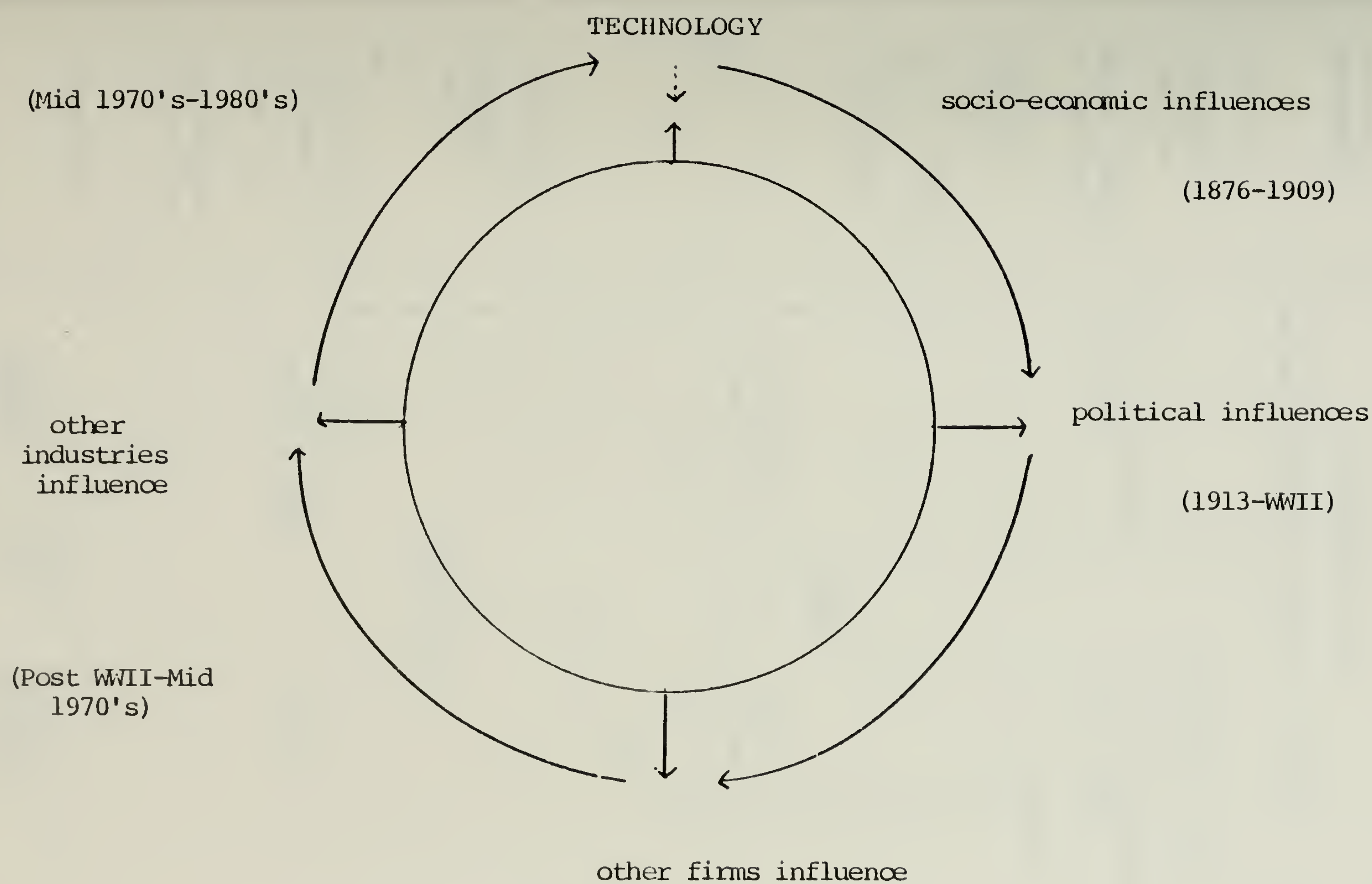
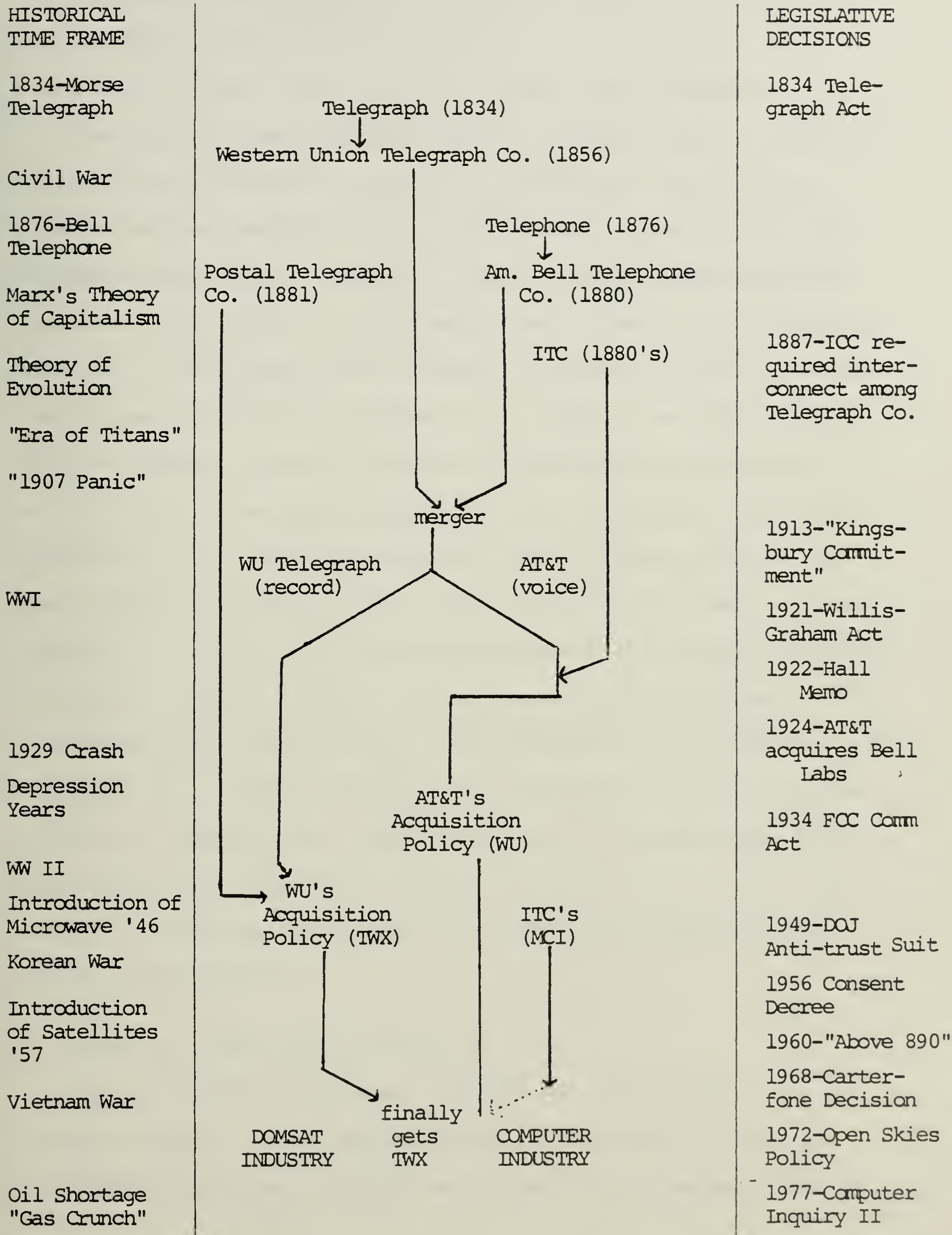



Figure 6. MAJOR INFLUENCES ON THE TELECOMMUNICATION INDUSTRY

Figure 7. TELECOMMUNICATIONS INDUSTRY IN HISTORY



telecommunications industry in terms of historical dates and the political decision-making system. The following is a discussion of each stage in the growth of the industry.

The mid 19th century saw America changing from an agrarian society to an industrial nation. It was the time of many innovations and technological creativity. Inventions became an American pastime. Indeed, it was also the coming of the business civilization. Along with the "spread of the railroad networks in the 1850s, the triumph of Northern capitalism over the Southern plantation system in the 1860s, the rise of investment banking and the process of rapid capital formation in the 1870s," came the invention of the telegraph and the telephone [31]. Thus the telegraph and telephone became the basic technology that was the beginning of the communications industry. At first, the telegraph aroused little passion from the public leading towards private ownership development. The two decades that followed saw the emergence of the Western Union Telegraph Co. and the entry of government regulation into the industry. Western Union was firmly on its way when the telephone came into existence, thereby ushering in not only a new concept in telecommunications but a whole new dimension in industry development.

## A. STAGE I: 1876-1909 (Figure 8)

The late 19th century was the era of big business and the "robber barons." This period has been described by many as a time of both class conflict and class consciousness. The

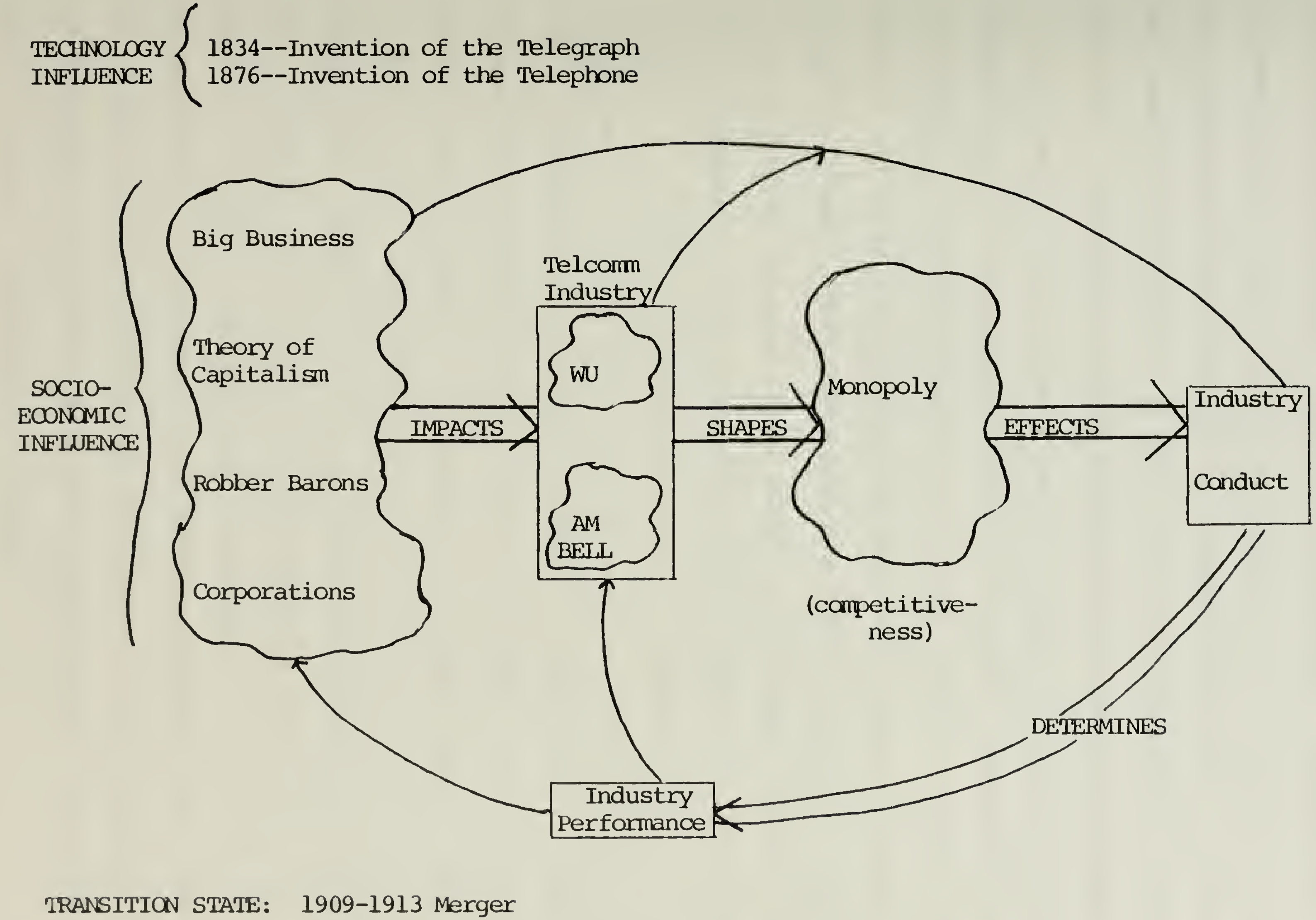



Figure 8. TELECOMMUNICATIONS INDUSTRY STAGE I: 1876-1909

influence of Marx's Theory of Capitalism and the "drive to industrial maturity" characterized the period where our society effectively applied the scope of technology to the bulk of its resources. There was a high disparity in wealth and power that accompanied the process of industrialization. It was a time when huge corporations displaced the independent entrepreneurs. The growth of the telegraph and telephone companies fit this mold. Both areas expanded rapidly through vertical and horizontal integration. When the Postal Telegraph Company, a subsidiary of the Commercial Cable Co., bought out the independents, it came into strong competition with the Western Union Telegraph Company (WU). The American Bell Telephone Company had reorganized several times within a few short years after the introduction of the telephone until AT&T finally emerged in 1885 as a wholly owned subsidiary of American Bell. The strategies of both WU and AT&T had been to expand separately with a philosophy of non-interference. The growth of these two companies (monopolies in their own right) was thus in a fairly stable internal environment. The president of AT&T had developed a "philosophy espousing AT&T as the single national monopolistic telephonic and telegraph communications system" [32]. However, by the turn of the century, the winds had started to shift. The expected expiration of the Bell patents saw an influx of independent telephone companies into the industry. AT&T not only maintained its hold on the telephone industry (through foresight and skilled maneuvering), but made a move to acquire the control of Western Union.

The four years of the merger (1909-1913) was a transition state for the telecommunications industry. The merger was viewed by many as making AT&T too powerful. "AT&T was on its way towards the single national system it wanted" [33]. With the merger came the beginning of a long line of increased government investigations, regulations, etc. The strategies and policies of the telecommunications industry now shifted to meet the challenges from a different environment--the political arena.

## B. STAGE II: 1913-WW II (Figure 9)

The 1913 "Kingsbury Commitment" was the beginning of a flurry of moves and counter-moves by the government to keep AT&T in line. WW I and the Depression contributed to the power growth of the government in this stage. With the mood of the country as one of anti-trust, AT&T's biggest competitor became the government. This relationship led to a change in AT&T's corporate policy to strategies that were based on a power struggle with the government. The men of AT&T "are men of power not because of their great fortunes or talents but because they have powerful instruments at their command" [34]. With the tremendous amount of resources at their disposal, both AT&T and the government kept each other in check up to WW II.

## C. STAGE III: POST WW II-MID 1970'S (Figure 10)

After WW II, the telecommunications industry entered into its next stage. A stage where other firms emerged to challenge the dominance of AT&T. The introduction of the microwave and

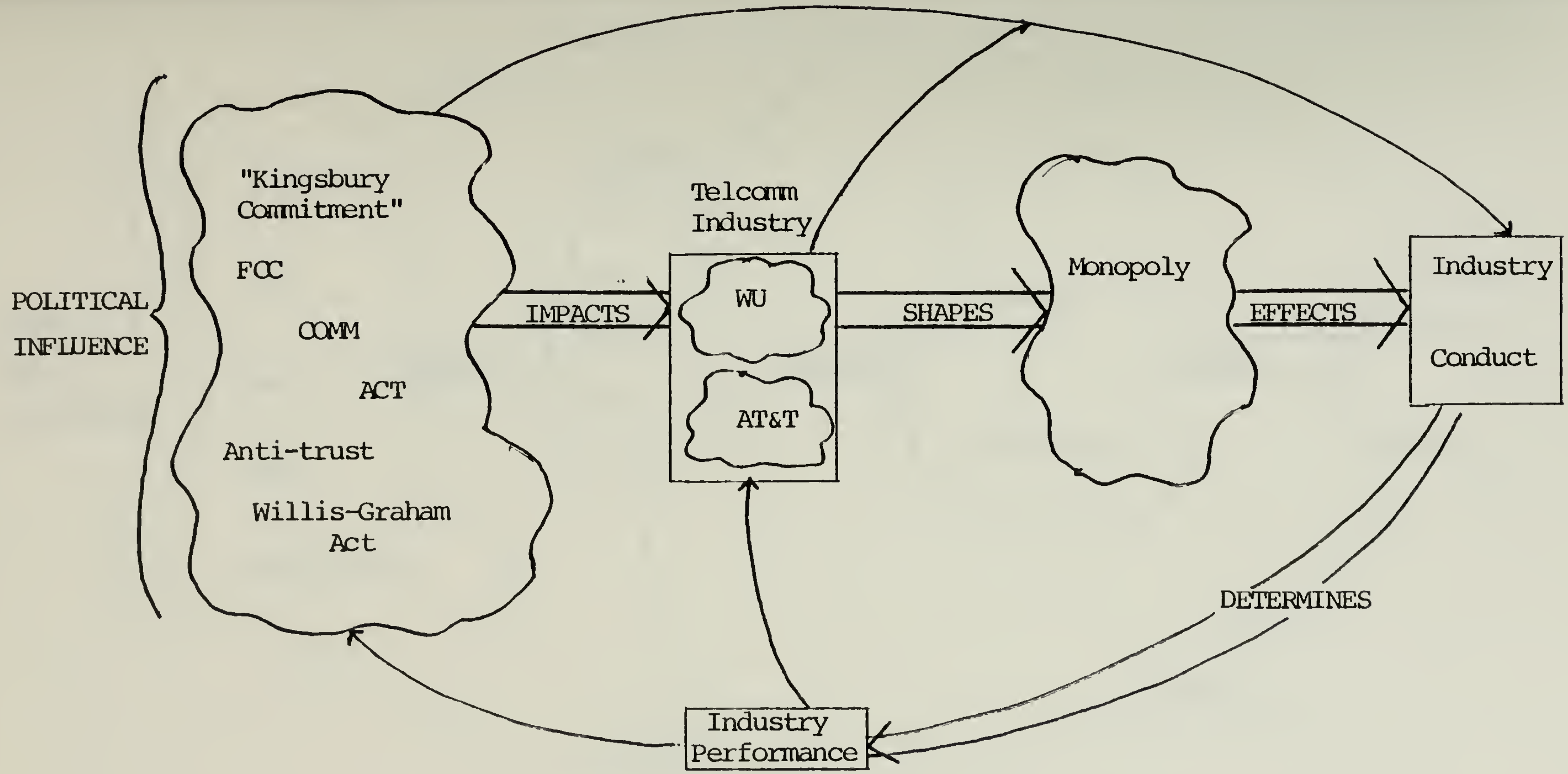



Figure 9. TELECOMMUNICATIONS INDUSTRY STAGE II: 1913-WWII

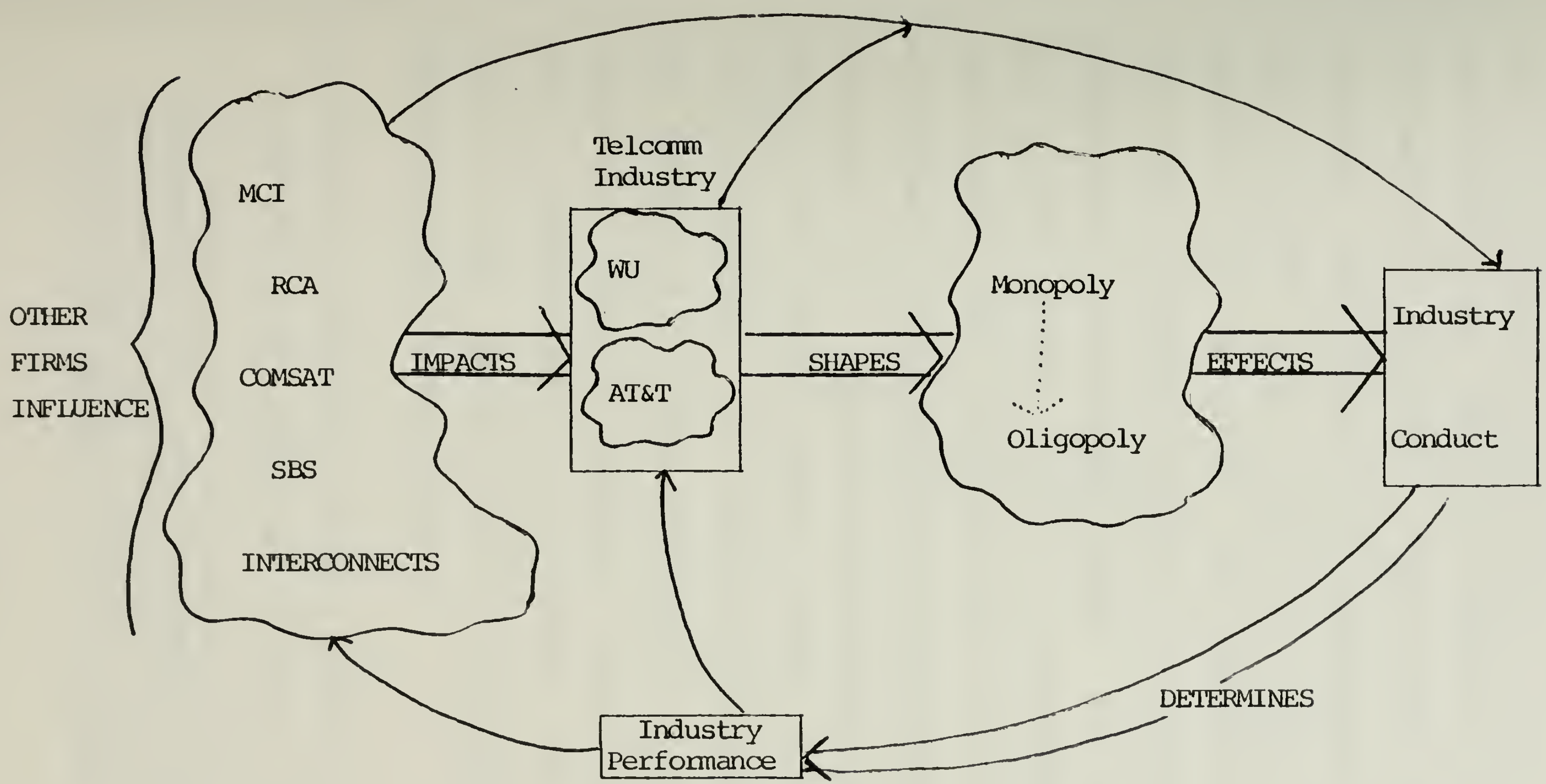



Figure 10. TELECOMMUNICATIONS INDUSTRY STAGE III: POST WW II-MID 1970'S

satellite as new medias of transmission, led to new interpretation of communications regulations. (Chapter IV is an in-depth look at the historical development of the satellite industry and Chapter V will cover the analysis of the domestic commercial satellite industry.) While facing the challenge on this new front, AT&T was also busy fighting the 1949 anti-trust suit which attempted to break up AT&T and open the door to more competition in the industry. The Consent Decree of 1956 however, left AT&T's structure intact but also barred the company from entering any non-regulated market. The "Above 890" decision, the 1964 MCI dispute, the FCC investigations and the 1968 Carterfone decision were the first major signs of change in the external environment in this stage of the telecommunications industry. The stable, non-competitive environment that safely surrounded AT&T for so long was gradually moving into a turbulent, competitive atmosphere. But through the 1960s and into the 1970s, AT&T continued its same monopolistic strategy, doing virtually nothing to change its conduct towards industrial competitors and the changed external environment. The 1970s brought no relief in sight for AT&T as the telecommunications industry moved into yet another stage.

## D. STAGE IV: MID 1970'S-1980'S (Figure 11)

> AT&T ran into nothing but trouble in the 1970s.
>
> It started with the FCC's Specialized Common Carrier Decision of 1971, then followed, in rapid succession, the Domestic Satellite Decision (which limited AT&T's domestic satellite activities), the Packet Communications Inc. Decision (which launched the value-added

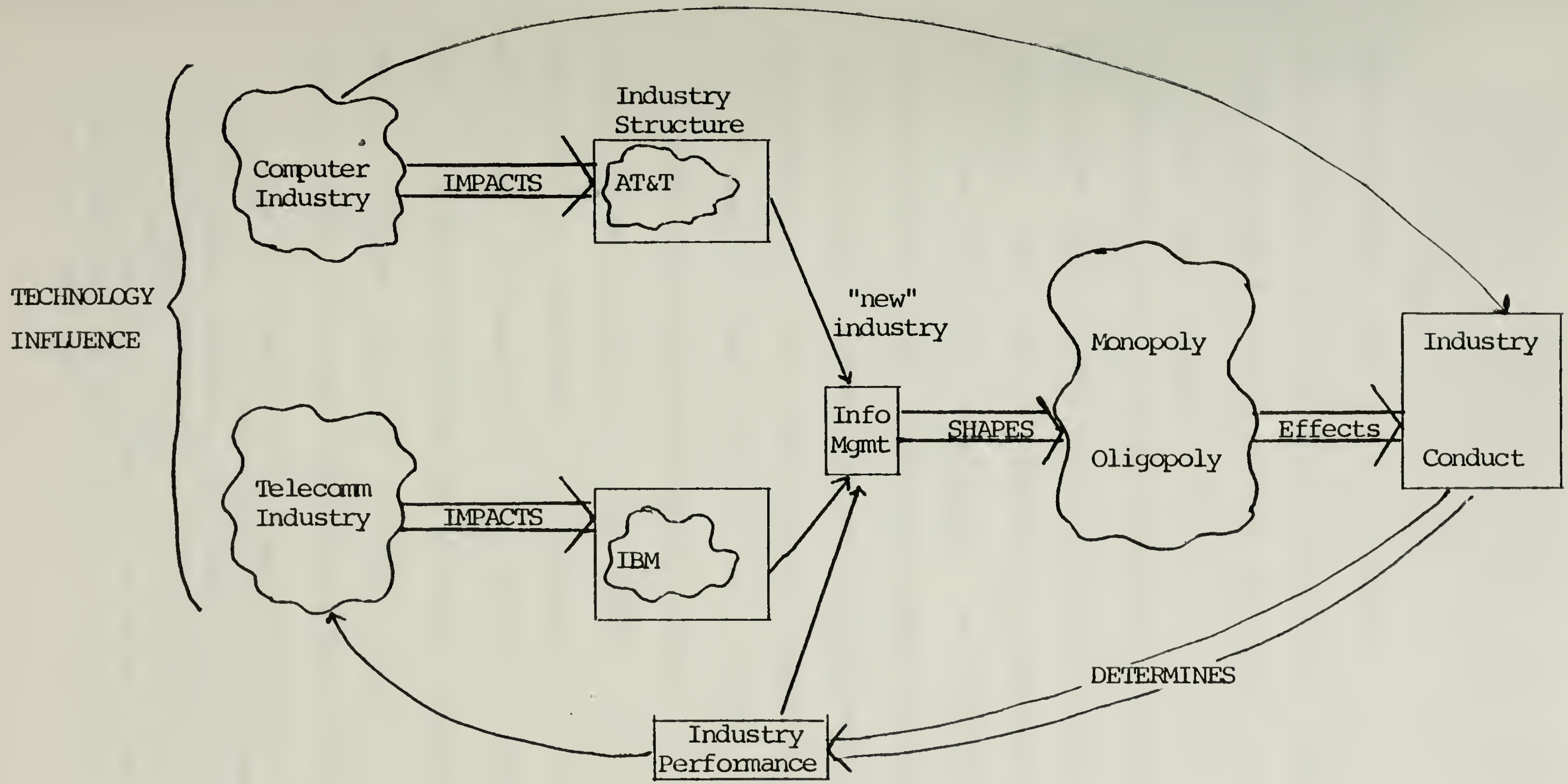



Figure 11. TELECOMMUNICATIONS INDUSTRY STAGE IV: MID 1970'S-1980'S

networks), Resale and Sharing (which prevented AT&T from giving bulk discounts to large users of its services), and Execunet (which resulted in AT&T being forced to offer local loop interconnection to its competitors). [35]

AT&T suffered another blow in 1980 in its anti-trust suit loss to MCI. Although AT&T immediately appealed the verdict, it may be years before a final decision is reached.

Despite the competition biting at AT&T's heels, the major driving influence from the external environment for this stage came from technology of another industry--the computer industry. With the computer being propelled by advances in mini-micro computer technology, the boundary layer between communications and data processing became muddled and unclear. A confrontation between the two superpowers, AT&T and IBM, was inevitable. In 1974, IBM formed a subsidiary to buy the interests in the Lockheed Aircraft Co. and MCI Communications Corp. in a domestic communications satellite venture that the two companies had formed with the COMSAT Corporation. This aggressive move by IBM brought an industry-to-industry confrontation even closer between regulated AT&T and competitive IBM. However, the decisions that accelerated the telecommunications industry's thrust into the transition period were the Computer Inquiry I and the most recent Computer Inquiry II.

> In this bold move (the Final Decision in Computer Inquiry II), the FCC abandoned its attempts at distinction between, and separate treatment of, telecommunications and data processing. These two functions, in the past viewed as separate disciplines and markets, are relentlessly merging and emerging within a single information management marketplace. [36]

The telecommunications industry has gone through four stages of development based on the environmental factors that played key roles in its development. The strategy taken by the industry giants to control the environment eventually led to the transition into the next stage. The telecommunications industry has gone through the full cycle. It's interesting to note here that it was technology that introduced the industry and it appears that it may be technology from another industry that will create a "new" industry with telecommunications as its basis.

AT&T successfully adapted its strategy to meet the environmental demands in the first two stages. Besides several internal structure reorganizations, its strategy changed from non-interference with WU to acquiring WU, then to finally dealing with the government as a competitor. In stage three and four, where AT&T's internal environment was seriously threatened by the competition (other firms and other industries), its strategies faltered. In the future, AT&T must attune itself to a strategy of marketing if it is to survive in the new competitive environment against IBM and the data processing market.

1. Telecommunications Industry Performance

The telecommunications industry is presently in a state of flux. Never before in its history has the telecommunications industry been in such a dynamic and turbulent environment. With the opening of its doors to the competitive world, AT&T is fighting for its very survival to maintain its hold as a dominant superpower in the telecommunications industry.

With AT&T losing ground in each anti-trust suit, IBM took the opportunity to seek growth in a market it now considered to be fair territory, the market of teleprocessing and information processing products.

These advances in technology however, are not the only causes of AT&T's problems.

> The phone companies . . . are locked into rigid regulatory accounting procedures that assume next year's revenues are as sure as tommorrow's sunrise. Dedicated to supplying high quality but rigidly standardized telephone service, AT&T managers, who have almost universally risen through operating, engineering, and financial ranks, are not attuned to marketing and innovations. [37]

In contrast, however, IBM's management strategy is geared towards marketing and its practices are more tuned for change and surprises.

In the non-competitive, monopolistic, pre-Carterfone era, there were essentially no standards by which product performance could be measured for the Bell System. Since legislative policy and FCC regulations kept AT&T as a provider of a public service at a reasonable cost, AT&T was seen as providing a "good" product. Even the FCC concluded that the telephone service was not only good, but that the U.S. telephone system was the finest in the world. Since 1968 and the introduction of competition, subscribers now had other products to compare with the Bell System.

> For the first time, comparison between Bell Telephone Laboratory (BTL)/Western Electric equipment and non-Bell equipment could be made with products being evaluated on their price, their quality, their cost and their merit . . . [38]

One of the three major areas that the FCC uses to analyze the various telecommunications products is switching [39]. At a recent 34th Annual AFCEA Convention, Mr. Seifert, the Director of Corporate Product Planning of Western Electric, points to the improved performance of the Bell System switching networks as a result of:

> Productivity and service response gains through extensive deployment of computerized (software-based) operations support (OS) systems; and the accelerating use of digital equipment in all portions of the network. [40]

One final comment is necessary in this area. The performance of an industry can and does effect the organization's structure as this author's model indicates. Mr. Seifert comments:

> In addition to the service and expense productivity improvements realized from these systems, their deployment has had a significant impact upon the structure of the Bell System operation work force. [41]

To understand technological progressiveness in the Bell System, one must look at Bell Telephone Laboratories--the research and development arm of the Bell System [42]. Once again, at the same panel discussion on switched networks at the AFCEA convention, Mr. Tom Powers, the Executive Director of Network Planning for BTL emphasizes their performance and technological progressiveness;

> With our existing Dataphone Digital Service we are providing point-to-point digital capability to an ever increasing market. Our ACS project will provide an intelligent packet switching service using basic digital facilities . . . Within a few years, we will be able to provide end-to-end switched circuits which our customers can use for either digital

voice or data under their control. These circuits will blend our new technology with our old . . . [43]

AT&T's concern for "high marks" in product performance and technological progressiveness is also related to the threat from the computer industry, IBM in particular. At stake is the so-called Office of the Future--"and which industry will supply the communicating typewriters, data-retrieval displays, and telephones with pushbuttons that double as calculators and as computer output and display devices" [44]. As the telecommunications industry and computer industry merge into the "new" information management market, the corporation that proves itself capable and efficient in the area of product performance and technological progressiveness will undoubtedly command the new industry.

The emergence of a new industry, with telecommunications as its basis, will also show a change in the major influence on the industry from the environment. Given the cyclical trend, soci-economical factors will again play an important part in industry structure, conduct and performance. Some of these signs are evident today. Conservation of energy, ecology, anti-nuclear power, ERA, Equal Employment Opportunity, the draft registration, genetics, solar heating, MBO, Organizational Development, the fight against inflation, etc., etc., are just some of the concerns our society is faced with today. In the near future, if not already, these concepts will shift our emphasis until all these values become a part of our society's social consciousness. Bell's "reach out and touch

someone" family-oriented advertising theme and IBM's focus on increasing the performance of other businesses through their computer systems, are indicators of the change in market strategy towards different social values. Clearly, the environmental factors will have a profound impact on industry performance as well as structure and conduct.

# IV. HISTORY OF SATELLITE DEVELOPMENT

## A. EARLY BACKGROUND

> An 'artificial satellite' at the correct distance from the earth would make one revolution every 24 hours: i.e., it would remain stationary above the same spot and would be within optical range of nearly half the earth's surface. Three repeater stations, 120 degrees apart in the correct orbit, could give television and microwave coverage to the entire planet.
>
> Arthur C. Clarke
> Wireless World, 1945

In October 1957 a small spherical object about the size of a beachball was circling the earth once every 96 minutes and traveling at a speed of 18,000 mph. This satellite, which emitted a beeping sound as it orbited the globe, ushered in the Space Age. An era of space age technology had arrived and with it, a race between the U.S. and the U.S.S.R. to put a man on the moon. The advent of the Soviet's SPUTNIK I in October of 1957 had astounded U.S. intelligence even though the Russians had made no secret of their satellites [45]. With America's reputation as a leader in scientific and technological achievement threatened, the U.S. was determined to get back in the race.

Shortly after the launch of SPUTNIK I, the U.S. followed with EXPLORER I in January 1958. Later that same year, the U.S. Army launched the world's first active communications satellite--Project SCORE. Although SCORE primarily tested boost capability of the Atlas rocket, it also evaluated the

first orbital communications transceiver [46]. The next satellite to follow in 1959 was COURIER. A direct descendent of the SCORE satellite, COURIER retained some of the basic characteristics of SCORE but was much more complex. COURIER was unique in that it was the first satellite to use solar energy for primary power with batteries as the backup [47]. "COURIER demonstrated the capacity to inject an artificial satellite into an earth orbit, remain operational for an extended period due to its solar panels, and facilitate the transmission and reception of data between two remote sites" [48]. By the early 1960's the space program was well established with NASA being responsible for most of the satellite R&D experiments. RELAY, which amplified and relayed signals and NASA's TELSTAR satellite, an active circuit type of communication satellite were launched in 1962.

1. Geo-synchronous Satellites

The next stage in satellite development was geo-synchronous satellites. Geo-synchronous satellites are satellites that are in orbit over the equator at such a distance that they appear to be stationary in the sky relative to the earth. NASA showed the feasibility of using geo-stationary satellites by successfully launching SYNCOM into synchronous orbit in 1963.

> Prior to the demonstration of SYNCOM II in 1963 there was concern expressed by prestigious communications organizations that the 260 millisecond time delay inherent in communications via synchronous satellite would be unacceptable to telephone users. Although early experiments with simulated time delays were

conducted, a demonstration of a working satellite was necessary to convince skeptics of the superiority of synchronous satellites. [49]

"Since SYNCOM, about 80 geo-synchronous satellites have been launched. Of these, 72 are communications satellites. Sixty-four were built and launched by the United States, 50 for operational rather than experimental use" [50].

## B. COMMERCIAL SATELLITES

The Communications Satellite Act, passed by Congress in 1962 formulated our national policy concerning satellites. Its purpose was

> to establish, in conjunction and in cooperation with other countries, as expeditiously as practicable, a commercial communications satellite system, as part of an improved global communications network, which will be responsive to public needs and national objectives, which will serve the communication needs of the United States and other countries, and which will contribute to world peace and understanding. [51]

The Communications Satellite Act formally established the Communications Satellite Corporation (COMSAT) as the United States' participant in the development of an international satellite system. COMSAT is considered a congressionally chartered private corporation. The Congress authorized COMSAT to offer international communications satellite services throughout the 1960's. COMSAT is able to offer communications services between the United States and foreign countries through the satellites of INTELSAT (International Telecommunications Satellite Organization).

1. INTELSAT

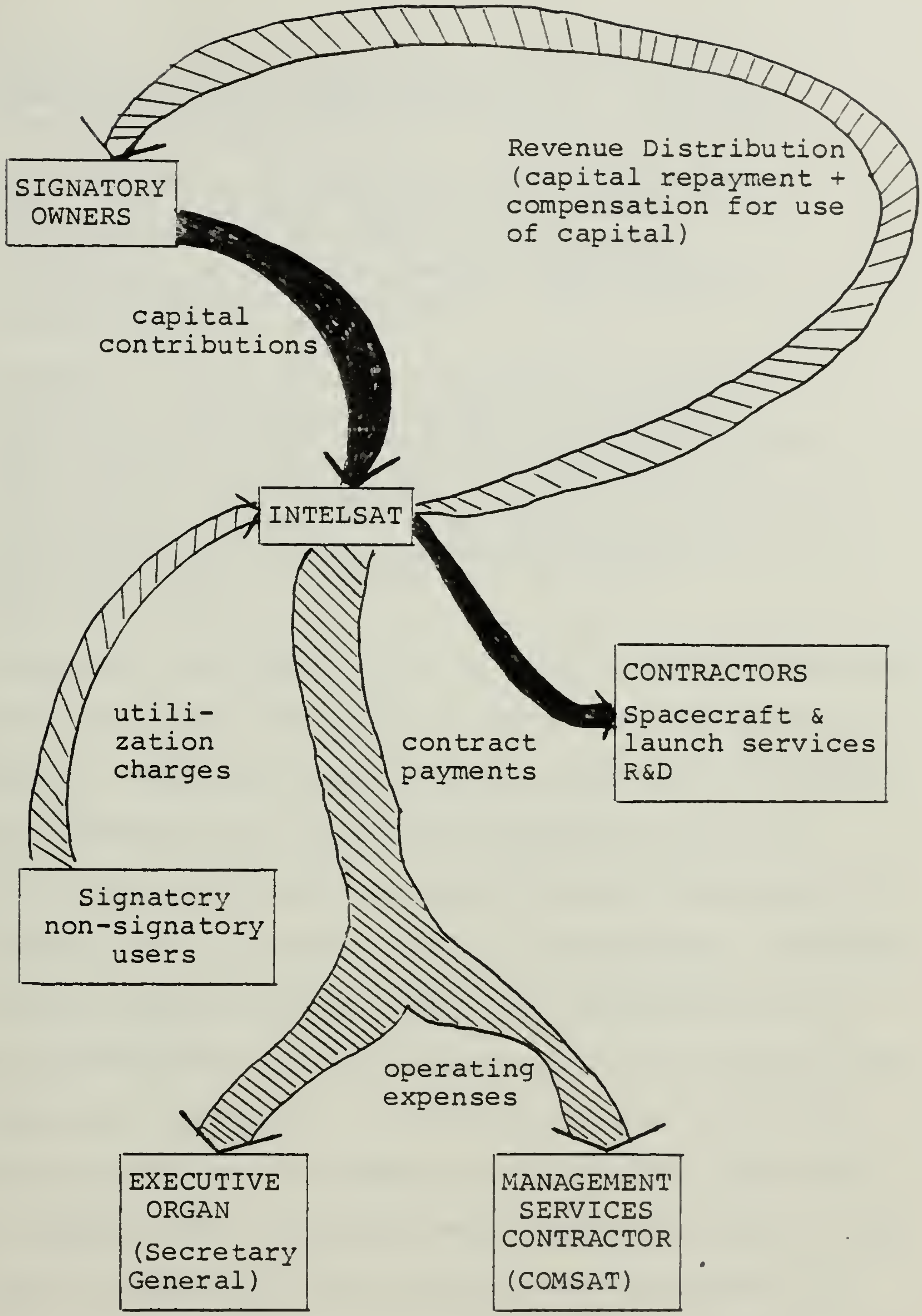
In April of 1965 the world's first commercial satellite, EARLY BIRD, was successfully launced from Cape Kennedy. With its advanced technology, the EARLY BIRD (INTELSAT I) satellite made live transoceanic television possible for the first time. The EARLY BIRD satellite was the first in a series of satellites launched by the INTELSAT organization. The satellites that soon followed were being designed with increased capacity to handle more communications traffic demands and longer design lives.

The INTELSAT organization was created in August 1964. INTELSAT is an organization that was formed to develop, implement and operate the space segment of the global system. The INTELSAT agreements are founded on the basic principle that

> the satellites utilized in the global system should be jointly financed and owned on the widest possible international basis, and that the extent of each participant's financial investment and ownership's share should be related as closely as possible to its potential use of the system. [52]

The space segment of INTELSAT is owned by the 105 members of the consortium. The individual ownership percentages are adjusted annually to reflect their relative current usage of the system and as new members join the organization. Fiugre 12 pictorially describes the normal INTELSAT financial arrangements which reflect the following steps in the cash flow process.

1. Each signatory contributes new capital investment, based on its ownership percentages, monthly as required to establish and maintain the INTELSAT system.




Source: Burton I. Edelson, H. William Wood and Carl J. Rober, "Cost Effectiveness in Global Satellite Communications," IEEE Communications Society Magazine, (January, 1977), p. 19.

Figure 12. INTELSAT Financial Arrangements, Simplified Cash Flow Diagram

2. INTELSAT invests such funds temporarily and then periodically makes payments for spacecraft equipment, launch services, and R&D contractors.

3. Each signatory or designated telecommunications entity (in countries that are not parties to the agreement) that uses the system pays utilization charges quarterly on the basis of a tariff schedule prescribed by INTELSAT for various types of services.

4. INTELSAT retains, from the revenues received, funds for current operating and maintenance expenses of its own organization and distributes the balance of the revenues to signatories on the basis of their ownership. The revenue distribution covers both a repayment of capital, consistent with the amortization recorded in the accounts, and compensation for use of capital. [53]

Throughout the 1960's, the INTELSAT organization experienced rapid growth and development. The EARLY BIRD satellite was followed by three more generations of satellites--INTELSAT II in 1967, INTELSAT III in 1968 and INTELSAT IV in 1971. Each of the satellite series had more advanced technology and greater communication capacity than its predecessor. INTELSAT II built by the Hughes Aircraft Corp. had the capability for multipoint communications and extended satellite coverage over most of the world. INTELSAT II consisted of two satellites, one over the Pacific and the other positioned over the Atlantic. The INTELSAT III satellites which established the global system, had the capability for simultaneous transmission of television, telephone, telex, data and facsimile. This series had satellites positioned over the Atlantic, Pacific and the Indian Oceans for complete world coverage. The INTELSAT IV series was designed to meet global system requirements for

the early 1970's. Although the INTELSAT IV series' major accomplishment over its predecessors was its "spot beam" transmitting antennas, its capacity for the first time was limited by available bandwidth and not by available power [54]. The current INTELSAT V is due to be launched in the 1980-1981 time frame. It has global, zone and spot beams to supply different communications capabilities to different regions and it also uses the 11/14 GHz bands as well as the 4/6 GHz bands [55]. Table 2 gives the characteristics of the INTELSAT satellites.

To illustrate how much communications traffic has increased since EARLY BIRD, COMSAT cites the following statistics:

1. In 1977, COMSAT was leasing 5,315 half-circuits full time to its U.S. communications carrier customers, compared to 66 in 1965. (A half-circuit is one end of a two-way communications link.)

2. At the end of 1977, 96 countries, territories, or possessions, were full-time users of satellite services with COMSAT, as opposed to 13 in 1965. [56]

2. Canadian TELESAT

Canada has established its own satellite system for domestic communications purpose. Their ANIK satellite was launched in November 1972 and established Canada as the first nation to use geostationary satellites for domestic communications. The coverage of the ANIK satellite extends from the East Coast to the West Coast and from the United States border to the Far North. The space segment has two satellites in

TABLE 2

THE INTELSAT SATELLITES

| | INTELSAT I EARLYBIRD | INTELSAT II | INTELSAT III | INTELSAT IV | INTELSAT V |
|---|---|---|---|---|---|
| YEAR OF LAUNCH | 1965 | 1967 | 1968 | 1971 | 1979 |
| DIAMETER | 28 inches | 56 inches | 56 inches | 93 inches | 600 inch sails |
| HEIGHT | 23 inches | 26 inches | 78 inches | 111 inches | 264 inches |
| WEIGHT IN ORBIT | 85 pounds | 192 lbs | 322 lbs | 1547 lbs | 3200 lbs |
| NUMBER OF ANTENNAS | 1 | 1 | 1 | 3 | 6 |
| PRIMARY POWER (WATT) | 40 | 75 | 120 | 400 | 1000 |
| NO. OF TRANS-PONDERS | 2 | 1 | 2 | 12 | 27 |
| BANDWIDTH PER TRANSPONDER | 25 MHz | 130 MHz | 225 MHz | 36 MHz | 36-241 MHz |
| COST OF SATELLITE | $3.6 Mil. | $3.5 Mil. | $4.5 Mil. | $14 Mil. | ≈25 Mil. |
| COST OF LAUNCH | $4.6 Mil. | $4.6 Mil. | $6 Mil. | $20 Mil. | ≈23 Mil. |
| DESIGN LIFE-TIME | 1.5 years | 3 years | 5 years | 7 years | 10 years |
| TOTAL COST PER YEAR | $5.47 Mil. | $2.70 Mil. | $1.90 Mil. | $4.85 Mil. | $4.8 Mil. |
| MAXIMUM NO. OF VOICE CIRCUITS | 240 or 1 TV channel | 240 or 1 TV channel | 1500 or 4 TV channels | 4000 and 2 TV channels | 13,400 and 2 TV channels |
| COST/VOICE CIR-CUIT/YEAR | $23,000 | $11,000 | $1,600 | $810 | ≈$200 |

Source: James Martin, Future Developments in Telecommunications. Prentice-Hall, Inc. Englewood Cliffs, N.J. 1977, P. 220 (NOTE: There is no reference as to whether constant dollars were used in the cost figures).

operation transmitting to over 70 manned and unmanned earth stations. The satellite is of the basic design developed by Hughes Aircraft and consequently this same design has been adopted by Western Union for their satellite development. Each satellite has twelve transponders each of which can be used for 480 duplex voice channels or one color television channel. The major customers served by this satellite are the Canadian Broadcasting Corp. (TV), Trans-Canada Telephone System, and the Canadian National and Canadian Pacific Railways [57].

## C. U.S. DOMESTIC SATELLITES

In 1965 the American Broadcasting Company (ABC) requested permission from the FCC to launch a satellite system for television distribution within the U.S. The FCC requested comments from interested parties on ABC's proposal and by December of 1966, three other proposals had been filed by the Ford Foundation, COMSAT Corp. and AT&T for domestic satellite systems. During the 1968-1969 timeframe, the President's Task Force on Communication Policy recommended a cautious approach to the development of satellite communications but favored the proposal set down by COMSAT. In 1970, the Administration outlined an "open entry" policy towards domestic satellite communications. This policy essentially stated any organization technically and financially qualified would be eligible to provide domestic satellite communications services. By 1972, the FCC in its Second Report and Order of June 1972 had approved the beginning

of domestic satellite communications for the United States.

1. COMSAT General Satellites

The COMSAT General Corporation was established in 1973 by COMSAT as its wholly owned subsidiary to carry out programs not related to the INTELSAT system. These programs included the COMSTAR and the MARISAT systems.

The COMSTAR satellites are the first to be integrated within the nation's telephone network. Providing service to the contigious 48 states, the satellites are leased by AT&T and GT&E for domestic communications. "Employing advanced techniques, each of the four delivered satellites can relay over 18,000 two-way telephone calls simultaneously, has a 7-year design life, is 20 feet high, and weighs 3,348 pounds at launch" [58].

The MARISAT satellite system is the first commercial satellite for use by merchant ships for ship to shore communications. MARISAT provides such capabilities as data and telephone communications between merchant vessels and shore establishments. What makes this system unique over previous maritime communications is that MARISAT is essentially unaffected by either weather or ionospheric conditions. Thus MARISAT can provide fast and dependable communications around the clock. The MARISAT system has three satellites that are positioned over the Atlantic, Pacific and the Indian Oceans.

In addition to providing maritime service, MARISAT has designated channels for use by the Navy. Termed the

"GAPFILLER" satellite, the Navy leased services from MARISAT for an interim period of time until the Navy's FLTSATCOM was operational.

2. Western Union Satellites

In 1974 Western Union launched WESTAR I and WESTAR II, the first U.S. domestic satellites. With primary coverage consisting of the 48 contiguous states, Hawaii and Puerto Rico, the WESTAR was designed to provide more communications flexibility and less cost for private communications systems. As a result, a price war developed for long distance leased communication channels in the United States. Using the WESTAR satellite a leased telephone circuit from coast to coast was less than half the cost of similar channels from the terrestrial common carriers [59]. Using dedicated earth stations, the WESTAR has become an integral part of the Western Union network providing such services as telex, TWX, Central Telephone Bureau, telegrams, data and facsimile in addition to point-to-point or point-to-multi-point video service. The WESTAR satellites have transponders (36 MHz bandwidth) which may be used to carry any of the following:

1. One color television channel with program sound.
2. 1200 voice channels.
3. A data rate of 50 Mb/s.
4. The center 24 MHz of each band may relay either
    a. 16 channels of 1.544 Mb/s or
    b. 400 channels of 64,000 b/s or
    c. 600 channels of 40,000 b/s. [60]

3. <u>RCA Satellites</u>

RCA was the first to provide domestic satellite service for the United States. RCA accomplished this in 1973 by leasing channel capacity from Canada's TELESAT system using the ANIK II satellite. RCA continued to lease transponders on the WESTAR satellite in 1974 and finally launched its own satellite, SATCOM, in 1975. Designed to provide voice, television and high speed data communications, RCA's three SATCOM satellites each have a 24 transponder capacity. SATCOM can simultaneously handle 24,000 one-way telephone messages or 24 color T.V. programs, weighs 2000 pounds and has an 8-year design life [61]. These satellites are authorized to provide service to all 50 states plus Puerto Rico. Similar to WESTAR, SATCOM satellites can provide private line common carrier service to all areas they serve. The service includes T.V. distribution to Alaska, private line and dial service within Alaska and between Alaska and the rest of the United States, private-line video, voice and data to government agencies and CATV program distribution to many small receive-only stations.

4. <u>American Satellite Corporation</u>

The American Satellite Corporation (ASC) which is jointly owned by Fairchild Industries and Continental Telephone had originally planned a three phase program beginning with a lease of transponders from Canada's ANIK II bird followed by a launching of their own satellites in 1975 and

1976. However, ASC made some drastic changes in their overall system planning. ASC now leases transponders from the WESTAR satellite. Although they do not have satellites of their own, ASC has approximately 40 earth stations installed. Specializing in providing voice and data communications to 5 and 11 meter earth stations, "American Satellite's implementation of small earth station technology was responsible for the landmark 1978 FCC decision allowing the transmission of data from 5 meter earth station antennas" [62]. Commissioner Joseph R. Fogarty issued the following statement at that time: "This is precisely the type of innovation which the Commission had in mind when we promoted competitive offering of domestic terrestrial and satellite services" [63].

5. Satellite Business Systems

In November of 1980, Satellite Business Systems (SBS) launched their first satellite; five years after they had filed with the FCC for approval to construct a domestic satellite system to provide private line networks. SBS, a partnership among wholly-owned subsidiaries of COMSAT General Corp., IBM and Aetna Life and Casualty Company is planning a second launch in April of 1981. The SBS satellite system offers the following features:

1. Use of the 12 and 14 GHz bands
2. All digital transmission
3. Integrated voice, data and image services
4. 5 and 7 meter earth station antennas located in most cases at the customers' premises

5. Minimum dependence on terrestrial interconnections

6. Centralized system management facilities

7. Facilities to enable customers to dynamically control and manage the use of their network. [69]

With its current state-of-the-art technology, SBS will be the

> first commercial satellite carrier to provide high capacity, private communications networks for business and government users having large volume communication requirements among geographically dispersed facilities. The networks will be fully switchable and provide users with a full range of communication services. . . [65]

## D. MILITARY SATELLITE PROGRAMS

The passage of the Communications Satellite Act of 1962 recognized the possibility that all the various requirements could not be satisfied by one system. Section 102(d) of that Act states "It is not the intent of Congress by this Act. . . to preclude the creation of additional communication satellite systems, if required to meet unique governmental needs or if otherwise required in the national interest." For several years afterwards, the policy of DOD concerning the use of its own government system was left in limbo. In 1965, hearings by the Subcommittee of Military Operations stated, "The DOD, after long and fruitless negotiations with COMSAT, now has decided to proceed with the development of a separate communications satellite system to fulfill urgent government requirements" [66]. There are some obvious differences between a system designed strictly for military purposes and one designed for a competitive commercial market. One major difference is

in the security and survivability requirements of a military system. Some distinctive military requirements are:

1. Positive operational control
2. Mobility and remote area access
3. Protection against physical attack
4. Protection against electronic countermeasures
5. Low capacity and secret message transmission
6. Separate frequencies for military use. [67]

Generally speaking, increasing the measures of any of these requirements tends to drive up the system cost. A point to be made here is that since not all user requirements have a need for all the above features, it is not necessary to satisfy all DOD requirements using strictly military communication satellites. Although Congress has stated that there will be separate military and commercial systems, an issue that is constantly arising is selecting which of the existing communications satellite systems should be used to satisfy specific user requirements. This issue is beyond the scope of this thesis and the ensuing discussion of DOD satellite programs will be focused on military satellite systems.

1. <u>Early DOD Satellite Programs</u>

One of the earliest developments by the Department of Defense in the area of satellite communications was the Initial Defense Communications Satellite Program (IDCSP) system in 1962. This program was the follow up to the first experimental use of satellites for military communications. "The

main objective of IDCSP (aside from its experimental purpose) was to provide an emergency capability for supplementing the Defense Communications System and to improve its provision of minimum communications for military command and control purposes" [68]. During the Vietnam War, IDCSP, the first semi-operational SHF system was used for voice and data communications.

After the earlier Defense programs were developed, two distinct paths of military satellite communications evolved--a strategic (SHF) point-to-point system and a tactical (UHF) satellite system [69]. Whereas strategic communications uses large fixed antenna sites ashore, tactical satellites were specifically designed to operate with shipboard, airborne and land-mobile terminals [70]. The DSCS satellite falls under the strategic system while the Lincoln Experimental Satellites (LES), TACSAT, and GAPFILLER are classified as tactical systems. The FLTSATCOM meets the Navy's needs in both the strategic and tactical arena.

In October of 1965, the Office of the Secretary of Defense (OSD) directed the establishment of a Tri-Service TACSATCOM R&D Program. This decision led to the development of three R&D satellites; LES-5, LES-6 and TACSAT which were launched in 1967, 1968, 1969 respectively. The LES satellites evaluated the utility of using communications satellites to satisfy tactical requirements and proved that UHF (around 300 MHz) communications is possible with earth terminals having relatively simple wide-beam width antennas [71]. The Tactical

Satellite (TACSAT) function was to provide communications between various mobile units including ships and aircraft. The TACSAT proved that it was possible to have an operational system that was feasible for tactical communications. The lessons learned and the knowledge gained from these early systems were incorporated into the concept of a Fleet Satellite Communications System (FLTSATCOM). But because of numerous delays in the acquisition and production cycle coupled with technical difficulties for this system, it was necessary to acquire a system to provide satellite communications to fill the gap between the TACSATCOM and the FLTSATCOM. This was accomplished through the GAPFILLER satellite.

2. GAPFILLER Satellites

The GAPFILLER program was implemented in 1973 in order to provide interim UHF satellite communications service to the Department of Defense because of the FLTSATCOM program delay. In 1973 the Navy awarded a contract to the COMSAT General Corporation to provide for the lease of a two satellite UHF service. This satellite also provides service to commercial maritime users under the name of the MARISAT system discussed previously. The GAPFILLER provides two narrowband (25 KHz) and one wideband (500 KHz) channels. There are three GAPFILLER satellites positioned over the Atlantic, Pacific and the Indian Oceans.

3. FLTSATCOM Satellites

The FLTSATCOM program was conceived because the Navy recognized the inherent weakness of HF Beyond Line of Sight

(BLOS) communications. FLTSATCOM was to provide the "24 hour all-weather availability, high capacity and low error rate needed to support modern communications command and control requirements" [72]. The mission of the FLTSATCOM spacecraft is "to provide reliable, worldwide communications relay links (except near polar regions) between ships and aircraft of the fleet and selected fleet ground stations, and between Air Force aircraft and air/ground terminals" [73].

The design of the FLTSATCOM is considered extremely sophisticated in comparison with other communications satellites. For example, FLTSATCOM design stresses overall "hardening" to enhance survival chances in orbit in case of nuclear attack. FLTSATCOM's many subsystems include the following:

1. Fleet Satellite Broadcast (FSB)
2. Naval Modular Automated Communications Systems (NAVMACS)
3. Secure Voice Communications System (SVCS)
4. Information Exchange Subsystems (IXS):
    a. CUDIXS (Common User Digital IXS)
    b. SSIXS (Submarine Satellite IXS)
    c. ASWIXS (Anti-submarine Warfare IXS)
    d. TADIXS (Tactical Data IXS)
    e. TACINTEL (Tactical Intelligence IXS)

A description of the various FLTSATCOM subsystems is not within the scope of this thesis. Table 3 gives the characteristics of the UHF MILSATCOM Program discussed to date.

TABLE 3

UHF MILSATCOM DEVELOPMENT PROGRESS

| | LES 5/6 | TACSAT | GAPFILLER | FLTSATCOM |
|---|---|---|---|---|
| LAUNCH YEAR | 1967/68 | 1969 | 1976 | 1978 |
| SAT. WT. IN ORBIT | 230/398 lbs | 1600 lbs | 720 lbs | 2219 lbs |
| DESIGN LIFETIME | 5 years | 5 years | 5 years | 5 years |
| COVERAGE | Earth coverage | EC | EC | EC |
| NO. OF CHANNELS | 1 | 1 | 3 | 23 |
| EIRP/CHANNEL (dbw) | 16.5/29.5 | 38.3 | 28 (wideband)<br>23 (2-narrowband) | 26 (8 Navy)<br>28 (2 Navy)<br>16.5 (12 AF)<br>27.1 (1 DoD) |
| KHz<br>CHANNEL BANDWIDTH | 300/500 | 425 | 24 (2 channels)<br>480 (1 channel) | 25 (10 channels)<br>5 (12 channels)<br>500 (1 channel) |
| ANTI-JAM CAPABILITY | No | No | No | Yes |
| NUCLEAR HARDENING | No | No | No | Yes |

Source: BGen F.S. McCartney, "FLTSATCOM Program Review: Requirements, Design and Performance," EASCON '78 Record (Sept. '78), P. 443.

### 4. LEASAT Program

Because of the increased costs and delays associated with the FLTSATCOM, Congress has become interested in other methods of obtaining satellite capability besides through the development/procurement method. It had already been demonstrated through the MARISAT (GAPFILLER) program that a leased satellite service could be obtained at a reasonable and competitive price. In 1977, following hearings before the House Committee on Appropriations, the Committee reported that the Navy should begin leasing satellite services rather than purchase additional satellites. The Navy argued against the recommendation stating that "long-term leases constrained its ability to take advantage of changes in technology, hybrid systems compromised use and control of satellites, and leases are generally more expensive than outright purchase" [74]. Based on its own investigation and study, the House Committee recommended that

> Henceforth, DoD should, in the committee's view, lease not buy communications satellites. The reason for the Committee's conclusion was that it found a picture of persistent problems extending over many years and over many programs. Delays and cost overruns are common in these programs. This is in contrast to commercial communications satellites which have a superior record . . . One of the primary findings of the study is that, in contrast to the commercial world, the DOD tries to take a few relatively large and revolutionary steps in obtaining communication satellites, whereas the commercial world takes smaller incremental steps with lower degrees of technical risk and hence lower risks in regard to both cost and schedule. [75]

The U.S. Navy, designated as the Executive Service for this project, contracted for the LEASAT services from Hughes Communications Service in late 1978. The Hughes contract calls for five years of service from four satellites. Each satellite will provide 13 discrete communications channels using nine transmitters as follows:

1. A Fleet Satellite Broadcast (FSB) channel employing SHF uplink on-board processing, with UHF narrowband downlink
2. A 500 KHz wideband channel at UHF
3. Six 25 KHz narrowband channels at UHF, each using a separate downlink transmitter
4. Five 5 KHz narrowband channels at UHF, all sharing a single downlink transmitter at predetermined power levels. [76]

Although LEASAT is a follow on to FLTSATCOM, the LEASAT offers some advanced capabilities not found on FLTSATCOM. Table 4 gives a comparison summary of the GAPFILLER, FLTSATCOM and LEASAT.

5. DSCS Program

The major operational DOD satellite communications system is the Defense Satellite Communications System (DSCS). The DSCS I satellite was placed in operation in 1967 and orginally utilized nearly-synchronous satellites. In 1974 the "Phase II" DSCS satellites were declared operational in both the Atlantic and Pacific areas. As a strategic satellite system, the DSCS II provides long haul communications for the NMCC (National Military Command Center). Within the WWMCCS (Worldwide Military Command and Control System) system,

TABLE 4

COMPARISON SUMMARY OF MILSATCOM SYSTEMS

| GAPSAT | FLTSAT | LEASAT |
|---|---|---|
| NEED | | |
| • INTERIM SATCOM FOR INCREASING # TERMINALS PENDING FLTSAT | • WORLDWIDE RELIABLE FLEET COMMUNICATIONS | • ESSENTIAL CONTINUITY & COMPLY WITH CONGRESS DIRECTION |
| USERS | | |
| • N-FLTBDCST, DATA, VOICE<br>• A-T&E | • N-FLTBDCST, DATA, VOICE<br>• A-GMF<br>• AF-SIOP PKG, DATA<br>• JCS/CINCS NET | • N-FLTBDCST, DATA, VOICE<br>• A-GMF<br>• AF-GMF (NO SIOP)<br>• JCS/CINCS NET |
| ACCESS TECHNIQUE | | |
| • WIDEBAND-FREQUENCY DIVISION + 2 NARROW CHANNELS | • CHANNELIZED FREQUENCY DIVISION-LOW RATE<br>• CHANNELIZED TIME DIV WITH DAMA | • CHANNELIZED TIME DIVISION (DAMA) - HIGH RATE |
| ADVANCED CAPABILITY | | |
| • NONE | • AJ FLTBDCST<br>• SECURE CMD<br>• AJ SIOP PKG | • AJ FLTBDCST<br>• AJ & SECURE CMD<br>• SECURE TELEM |

N = Navy  A = Army  AF = Air Force  T&E = Test and Evaluation
SIOP = Single Integrated Operation Plan  DAMA = Demand Assigned Multiple Access

Source: NAVAL ELECTRONICS SYSTEMS COMMAND LEASAT MASTER PLAN Sept. 1978. P. 1-3

the DSCS II is designed to supply high capacity, reliable, independent communications capability in support of peacetime operations as well as contingency and wartime operations [77]. Through the 1980's, the next phase of the DSCS program, DSCS III, will provide SHF communications with global coverage for the Department of Defense. This series of satellites is expected to have substantial improvements in the area of survivability, reliability and flexibility.

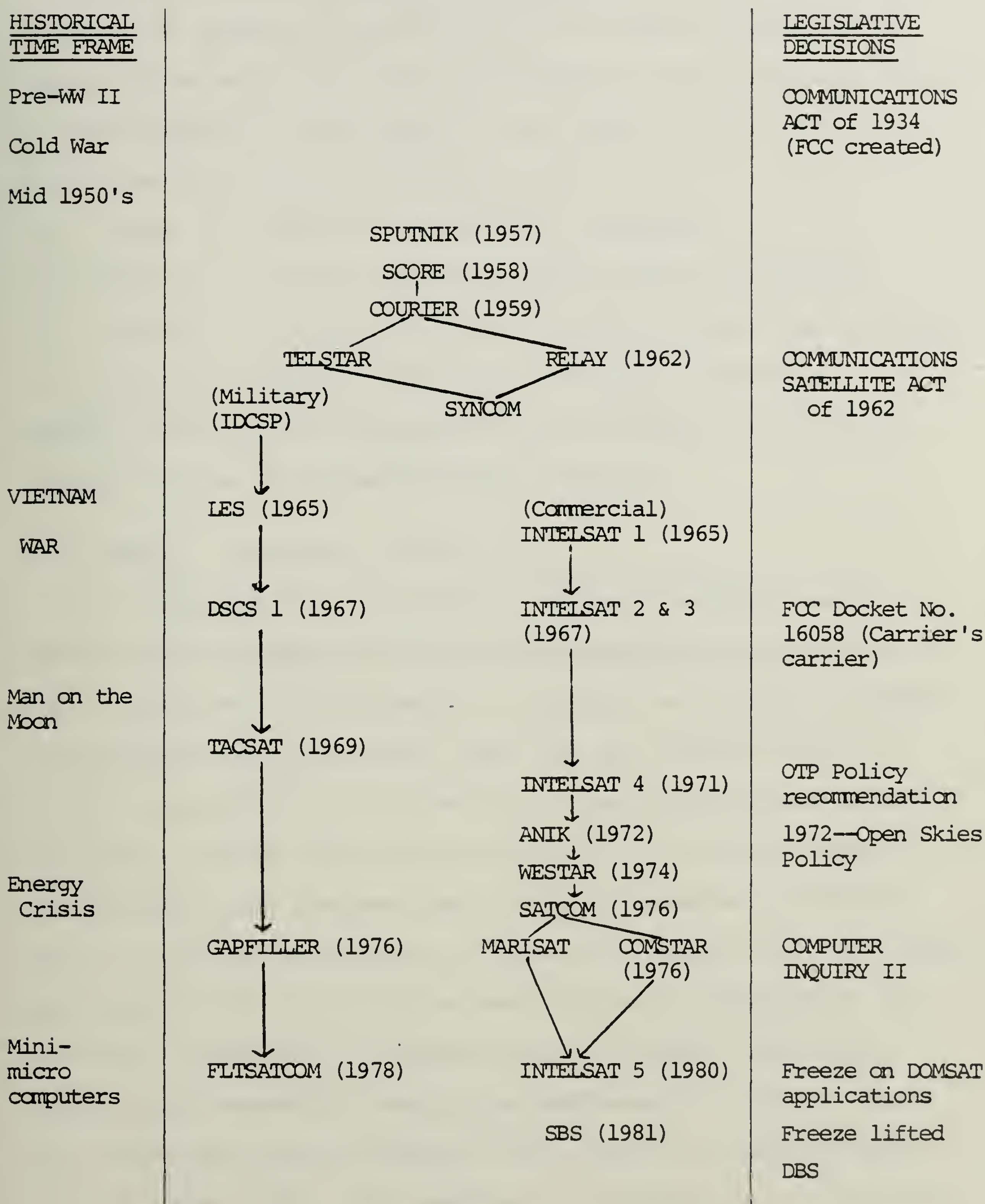
# V. THE DOMESTIC COMMERCIAL SATELLITE INDUSTRY: A MODEL

> This nation has traditionally followed a policy of conducting international telephone, telegraph and other communication services through private enterprise subject to governmental control, licensing and regulation. We have achieved communication facilities second to none among nations of the world. Accordingly, the Government should aggessively encourage private enterprise in the establishment and operation of satellite relays for revenue producing services.
>
> President Eisenhower
> December 30, 1960

The launching of the world's first communication satellite in 1958 added another significant dimension to the growth of the telecommunications industry. A new technology was introduced that would have a profound impact not only on the telecommunications industry but on the entire world as well. What was not anticipated by most however, was the rapid growth and development of satellite communications into many areas of our society in just over two decades. From the initial "beep" of the signal from space in 1957, our society has progressed to the point where direct home satellite reception for the majority is just around the corner. Figure 13 reflects the development of the satellite industry in an historical perspective as discussed in Chapter IV.

Comparable to the development of the telecommunications industry, the domestic commercial satellite industry follows a similar pattern of progression through several stages based

Figure 13. Satellite Communications Industry in History



on factors that help shape the industry. Because of the rapid advances in satellite technology, the industry moved through the same stages of influence in 20 years as did the telecommunications industry in 150 years. The stages of the domestic communications satellite industry are:

1. Stage I: 1958-1972 (Political influence)
2. Stage II: 1972-Mid 1970's (Other firms' influence)
3. Stage III: Mid 1970's-1980's (Other industries' influence)
4. Stage IV: 1980's-2000 (Socio-economic influence)

Figure 14 shows the relationship of the domestic satellite industry to the telecommunications industry.

## A. STAGE I: 1958-1972 (Figure 15)

The Communications Act of 1934 established the Federal Communications Commission as an independent regulatory agency for the purpose of "regulating interstate and foreign commerce in communication by wire and radio so as to make available, so far as possible, to all people of the United States a rapid, efficient, nation-wide and worldwide wire and radio communication service with adequate facilities at reasonable charges" [78]. With the introduction of satellite technology, new issues were raised that would not be satisfactorily answered by the 1934 Act. Questions of competition, ownership, operation, markets and boundaries were being addressed by various interest groups who saw the potential of satellite communications for the future [79]. But despite the implication of President Eisenhower's statement in 1960 for a viable satellite industry,

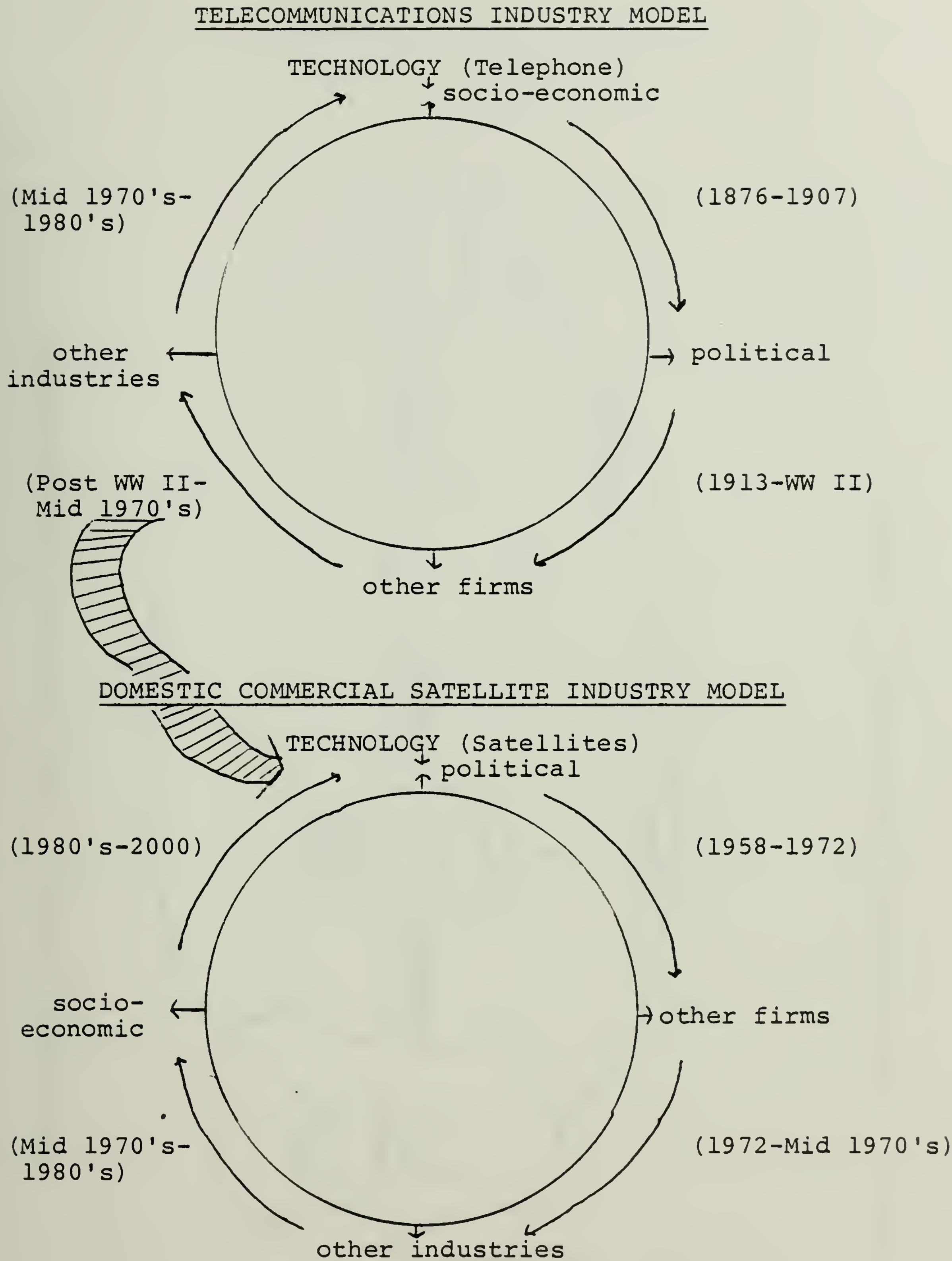



Figure 14. MODEL OF DOMESTIC COMMERCIAL SATELLITE INDUSTRY

TECHNOLOGY INFLUENCE: 1957--first satellite launched

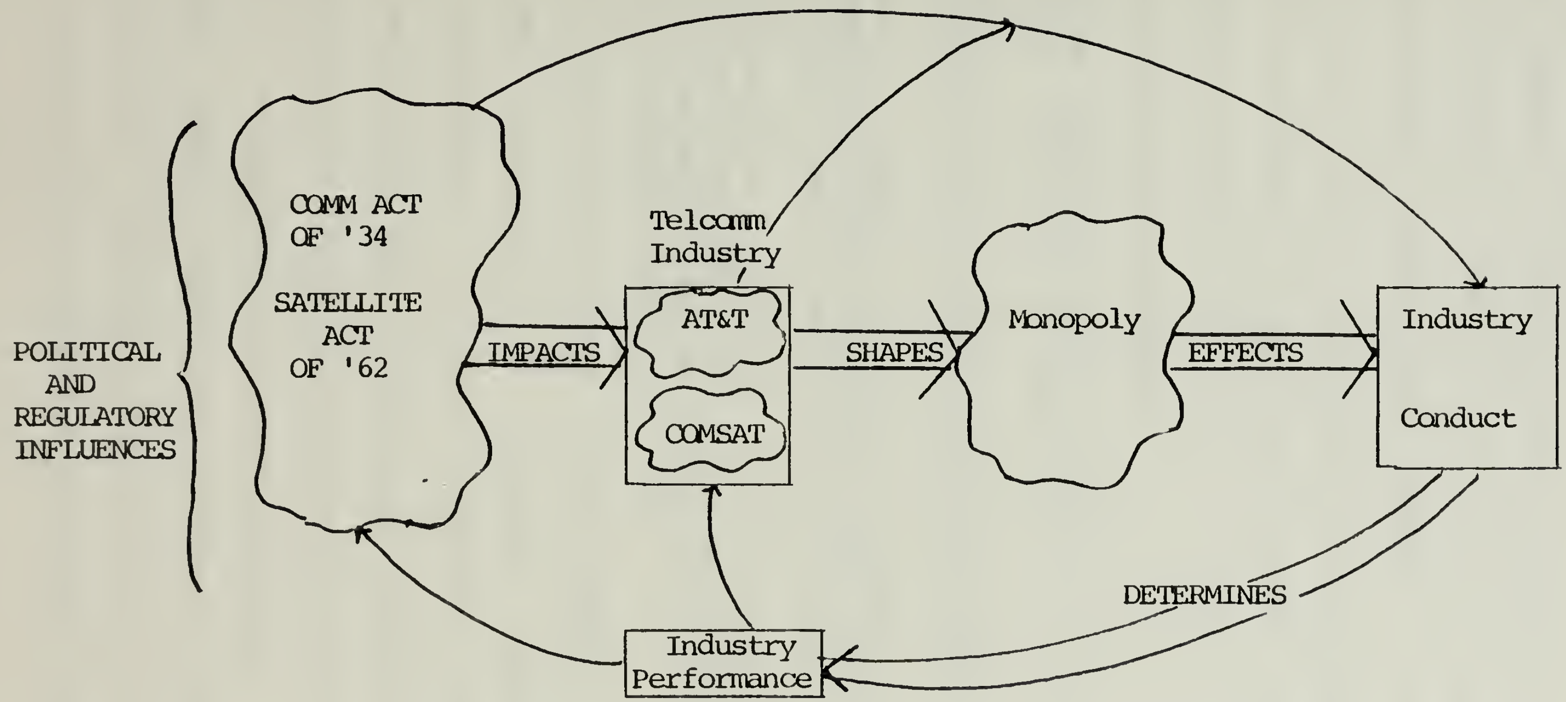



Figure 15. Domestic Satellite Industry Stage I: 1958-1972

policy guidance and legislation in the early 1960's prevented competition in the domestic satellite (DOMSAT) industry for at least another decade.

In the summer of 1961 President Kennedy outlined his policy for U.S. leadership in satellite communications that would lead to global coverage and universal benefit. The heart of his new policy was "private ownership and operation of the U.S. portion of the system, joined with certain public interest requirements and objectives" [80]. Other critical points of the policy guidelines included:

1. Foreign countries would be invited to participate through ownership or otherwise.

2. Communications carriers would have access on an equitable and non-discriminatory basis.

3. Effective competition would be sought in the purchase of system equipment, and measures taken to prevent narrow ownership and monopoly control.

4. All satellite launchings in the United States would be under the control of the government, which would also undertake to assure effective use of the radio frequency spectrum. [81]

In the year that followed, heated debates took place in Congress over the question of ownership. There were three proposals introduced in Congress concerning ownership [82]. The first by Senator Kerr of Oklahoma called for the creation of a communications satellite corporation which would be entirely owned by U.S. communications common carriers. The second was a White House proposal that was in effect a compromise between private and public ownership and the third proposal by Senator Kefauver, called for an entirely government-owned satellite

system which would not be dominated by the commercial common carriers.

The dominant communications common carriers were generally opposed to the "private ownership by non-carriers" proposal. AT&T's Vice President James E. Dingman in testimony before the Senate concluded that although satellite communications was not really a major breakthrough and essentially had no practical domestic application, the carriers would help advance satellite communications [83]. He stated:

> This position may be construed by some as stemming from the selfish interests of my company which is the largest of all carriers involved. Let me assure you that it is not.
> Let one thing be crystal clear: AT&T has no desire or intention of seeking to control the communications satellite system to its competitive advantage . . . Hard as it may be for some to understand, our sole interest is in the earliest practicable establishment of a world-wide commercial satellite system useful to all international communications carriers and agencies both here and abroad [84].

1. <u>The Communications Satellite Act of 1962</u>

When the dust settled and the debates concluded, it was the White House proposal that was adopted. It was in August of 1962 that President Kennedy signed into law the Communications Satellite Act of 1962. This act created the Communications Satellite Corporation (COMSAT) which was to carry out the following functions:

1. Plan, initiate, construct, own, manage, and operate, iteself or in conjunction with foreign governments or business entities, a commercial satellite system;

2. Furnish, for hire, channels of communication of United States communications common carriers and to other authorized entities, foreign and domestic; and

3. Own and separate satellite terminal stations when licensed. [85]

The Act of 1962 essentially states that COMSAT will operate as a "carrier's carrier" in the global satellite communications system. It can provide transmission services only to the authorized common carriers and not to the general public. Since COMSAT is a congressionally chartered private corporation, Congress made provisions for common carriers to own up to 50% of COMSAT's Board of Directors while the other 50% was issued to the general public. Also, only COMSAT or COMSAT in conjunction with foreign governments may own the satellite of the international communications satellite system. In effect, this Act stifled and delayed competition in the DOMSAT industry for many years.

The history of satellite regulation in the following years showed that federal regulation stunted even further the growth of satellite communications. Just four years after the passage of the COMSAT Act of 1962, the FCC eroded the powers of COMSAT in international communications.

> First, with its earth station decision, the FCC removed COMSAT control over a major portion of the system. Then, with its authorized user policy, the Commission prevented COMSAT from selling channels directly to CBS, Associated Press, UPI, the Washington Post, Eastern Airlines and a host of other companies that wanted to send information via satellite instead of through conventional, and far costlier, undersea cable. [86]

2. FCC Docket No. 16495

The use of domestic satellites was first proposed to the FCC in September 1965 when ABC filed an application for a domestic satellite to distribute program material to its affiliated television broadcast stations. The Commission noted that their application raised some interesting legal questions and therefore issued a Notice of Inquiry in March 1966, Docket No. 16495--In the Matter of the Establishment of Domestic Noncommon Carrier Communications Satellite Facilities by Non-Government Entities.

Of all the responses made to the Inquiry, the Ford Foundation proposal brought the questions about a domestic satellite system to the forefront of public discussion and government decision [87]. The key issue brought on by their reply to Docket No. 16495 centered on whether the Communications Act of 1934 or the Communications Satellite Act of 1962 is the exclusive Act concerning domestic satellite communications. Table 5 summarizes the legal position of AT&T, COMSAT, Western Union, Ford Foundation and ABC concerning the applicability of both these laws.

Following extensive hearings and pleadings over the next four years, the FCC adoped on March 20, 1970 its First Report and Order which is summarized below:

1. Unlike the international sphere, where COMSAT is the only provider of satellite service to the U.S., multiple suppliers of satellite services should be authorized in the domestic sphere;

TABLE 5

SUMMARY OF LEGAL POSITIONS

| | FCC can sanction domestic system only by authority of Communications Act of 1962 | FCC can sanction domestic system only under authority of Communications Act of 1934 | Only COMSAT is legally authorized to put up space segment of domestic satellite system | FCC has legal right to authorize a nongovernmental non-common carrier satellite entity | FCC has legal right to authorize an entity as proposed by Ford Foundation | COMSAT ownership of domestic system would involve conflict of interest in regard to international operation |
|---|---|---|---|---|---|---|
| AT&T | | X | | X | | |
| COMSAT | X | | X | | | |
| Western Union | X | | X | | | |
| Ford Foundation | | X | | X | | X |
| NBC | | X | | X | | X |
| CBS | | X | | X | | X |
| ABC | | X | | X | | X |

Source: Stuart N. Goodman, "Legal Issues Concerning Domestic Satellite Communications," Telecommunications, Vol. 4, No. 4, April 1970, p. 47.

2. there was no legal basis for COMSAT to be the sole supplier of domestic satellite services, but neither was COMSAT precluded from the domestic sphere;

3. the establishment of multiple domestic satellite systems was compatible with our obligation to INTELSAT; and

4. applications would be accepted from any qualified entities pursuant to the requirements set forth in the order. [88].

With a shift in attitude and policy towards domestic satellite communications, the Office of Telecommunications Policy (OTP) also recommended that any financially and technically qualified entity should be allowed to operate domestic satellite facilities. By 1971, the FCC was formulating its "Open Skies" policy. A policy that by 1972 would change the entire complexion of the DOMSAT industry.

Throughout Stage I of the domestic satellite development, the political influence and regulatory constraints in the external environment had severely hampered the growth of domestic satellites. Between the legislative decisions and the FCC rulings, satellite communications remained an integral but small part of the telecommunications industry.

The political and regulatory constraints placed on the domestic satellite development in Stage I can be looked at from another perspective as well. The telecommunications industry with AT&T at the controls was starting to shift towards a more competitive environment starting with the "Above 890" Decision in 1959 and culminating in the 1968 Carterfone Decision.

Since competition itself didn't enter the telecommunications industry until the end of the 1960's, there was no reason to believe that the government would have blessed a completely competitive environment in the domestic satellite development at the onset--a trend that would have been contrary to the telecommunications industry development.

AT&T also had a reason for wanting tight controls on satellite technology. During the 1950's the transoceanic submarine telephone cable was perfected with hundreds of times more capacity than telegraph cables and the ability to provide high quality communications [89]. With AT&T's investments in and the dramatic growth of the submarine cable, AT&T and other carriers felt threatened by the intrusion of satellite technology into their territory and the potential for a better and cheaper means of communications. Consequently, the common carriers had "assumed a variety of positions designed to neutralize and minimize the effects of communications satellites on established markets" [90]. On the side of AT&T was the government. As with shortwave radio, telegraph cables and telephone cables,

> new developments in communication technology frequently affect the economic viability of previous communication modes, but governmental action or regulation frequently intervene to prevent any major financial losses to the communication entities which may be involved. [91]

## B. STAGE II: 1972-MID 1970'S (Figure 16)

In response to the March 1970 FCC Report and Order and their Notice of Proposed Rulemaking which addressed questions

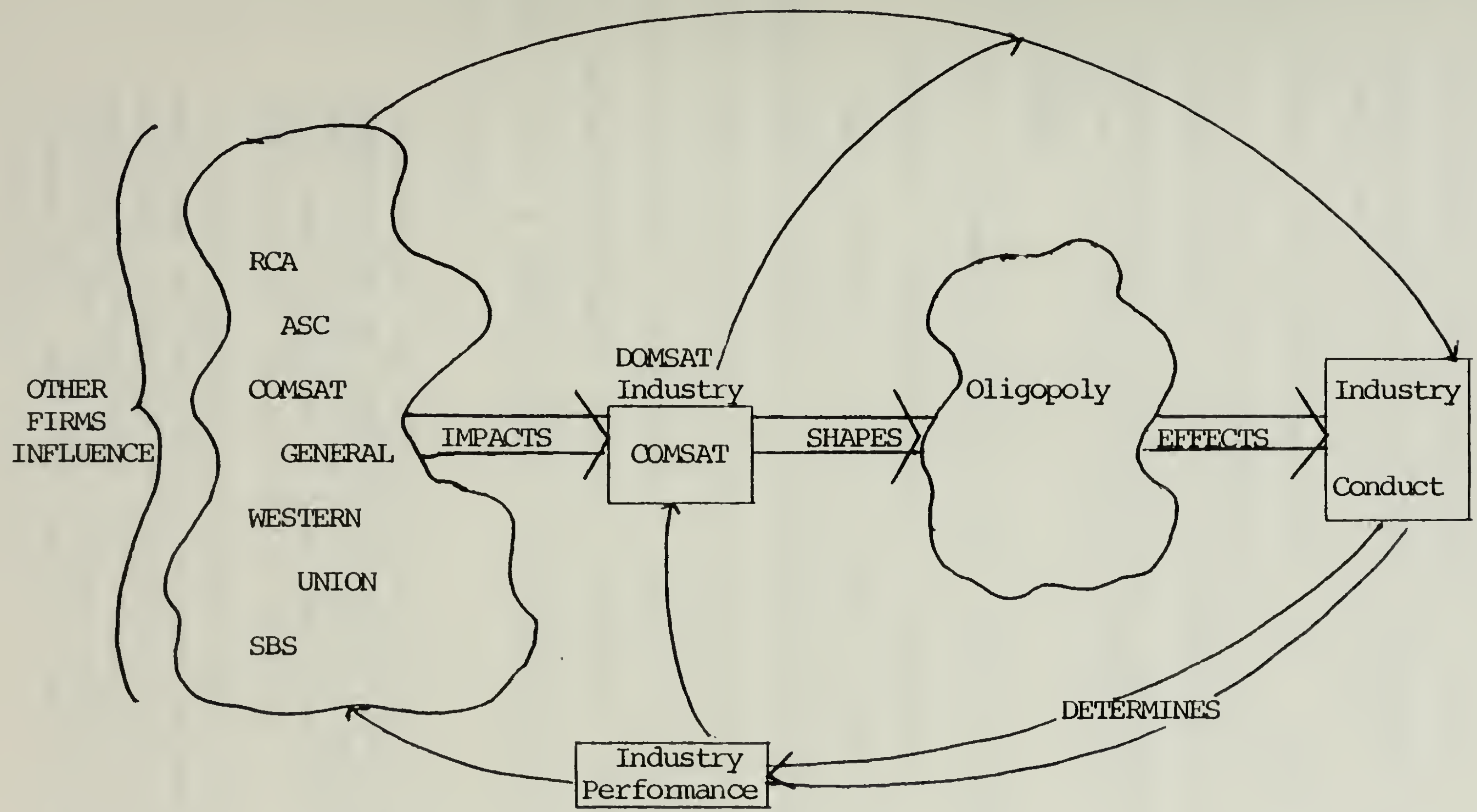



Figure 16. Domestic Satellite Industry Stage II: 1972-Mid 1970's

relating to procurement policies and the appropriate initial role of AT&T in domestic satellites, eight applications for DOMSAT systems were filed. The applicants were:

1. The Western Union Telegraph Co. (Western Union)
2. Hughes Aircraft Co. and four telephone operating companies of GTE Service Corporation. (Hughes/GTE)
3. Western Tele-Communications, Inc. (WTCI)
4. RCA Global Communications Inc. and RCA Alaska Communications, Inc. (RCA GLOBCOM/RCA ALASCOM)
5. Communications Satellite Corp. and American Telephone and Telegraph Company (COMSAT/AT&T)
6. COMSAT
7. MCI Lockheed Satellite Corp. (MCI Lockheed)
8. Fairchild Industries, Inc. (Fairchild) [92]

The next year and a half saw a flurry of proposals, deliberations, hearings and rebuttals by the eight applicants and the FCC on the exact nature and form that the domestic satellite service should take. Finally on December 27, 1972, the Commission released its Final Report. The Commission stated that its broad domestic satellite policy objectives were as follows:

1. To maximize the opportunities for the early acquisition of technical, operational and marketing data and experience in the use of this technology as a new communications resource for all types of service;
2. to afford a reasonable opportunity for multiple entities to demonstrate how any operational and economic characteristics peculiar to the satellite technology can be used to provide existing and new specialized services more economically and efficiently than can be done by terrestrial facilities;

3. to facilitate the efficient development of this new resource by removing or neutralizing existing institutional restraints or inhibitions; and

4. to retain leeway and flexibility in our policy making with respect to the use of satellite technology for domestic communications so as to make such adjustments therein as future experience and circumstances may dictate. [93]

This Final Report also placed some restrictions on COMSAT and AT&T. For COMSAT to be eligible to participate in DOMSAT ventures, it was required to form a separate corporate subsidiary; AT&T was limited to using DOMSAT for its noncompetitive services but would be allowed to openly compete in both competitive and noncompetitive markets after three years [94].

1. <u>The Emerging DOMSAT Industry</u>

Under a policy of open entry during the formative years of the industry, the most important factors governing the structure of the DOMSAT industry were the nature and structure of current and latent markets served by satellite communications, the nature of satellite communications services and their cost [95]. The emerging DOMSAT market structure stemmed from the structure of the telecommunications industry--a natural monopoly under AT&T. The markets that AT&T supplied naturally were conditioned by a history of monopoly-supplied services and, as a result, would take a few years for suppliers to enter the market on a competitive basis. While AT&T had the market for the long haul transmission business in the U.S. with COMSAT as the supplier of its satellite services, the smaller market sectors looked to other areas and other

suppliers to meet their needs. Since AT&T was kept out of the competitive markets for satellite services for several years, it gave the smaller companies such as GTE, WU and RCA a chance to develop their market strategies and efforts towards latent markets. Some of the services included in the latent markets are program distribution to CATV (Cable TV) systems and a broader variety of leased line services for business and government users [96]. It will be in these markets that competition among firms in the industry for satellite services will be the strongest by the end of the 1970's.

While the hearings and debates were ongoing at the FCC on the question of a domestic satellite policy, the Office of Telecommunications Policy (OTP) was concerned with what form the future DOMSAT industry structure would take. OTP commissioned several studies to be done on the technology and economics of domestic satellite communications. The Stanford Research Institute's study on the "Economic Viability of the Proposed United States Communications Satellite Systems" was to examine the potential outcome of an open entry policy. Tables 6 and 7 reflect the results of the study relative to the potential structure of the DOMSAT industry through the 1970's based on the FCC applications for satellite services by the eight corporations.

2. <u>Growth of the DOMSAT Industry</u>

Within three years of the "Open Skies" Policy, the domestic satellite communications field had made significant

TABLE 6

SATELLITE SYSTEM APPLICANTS AND THEIR ATTRIBUTES

| Applicants | Group Attributes |
|---|---|
| AT&T-Comsat | Assured market for proposed capacity. |
| Hughes | Coexist with other applicants, minimum competition interaction. |
| | High probability of establishing proposed system soon. |
| Comsat | Seek monopoly authorization by FCC. |
| Fairchild Hiller | No assured markets. |
| | Proposed capacity too large for viable co-existence with other applications. |
| | Very low probability that both systems would be established; joint undertaking unlikely. |
| Western Union | Must sell substantial excess capacity in competitive market. |
| Western Tele-communications<br><br>MCI Lockheed | Assured current demand too small for initial viability with proposed capacity, or with capacity of smallest efficient satellite system--two satellites, 12 transponders each. |
| | Willing to compete in pluralistic industry structure. |
| | Will compete for broadcast network market; winner must invest in additional earth stations, but would have advantage in leased-line market. |
| | High probability that at least one firm will establish a system soon; joint undertaking of two or three firms is likely; second system possible; low probability of more than two systems total from group. |

Source: Stanford Research Institute, "Economic Viability of the Proposed United States Communications Satellite Systems," (October 1971), p. 86.

TABLE 7

PROJECTED INDUSTRY STRUCTURE
Mid-1970's--Open Entry

| Applicants | Implemented System |
|---|---|
| AT&T | 72 transponders in 3 satellites, totaling $145 million investment.<br><br>5 major transmit-receive stations in New York, Los Angeles, Chicago, Dallas, and Atlanta, totaling $65 million investment. |
| Hughes | 24 transponders in 2 satellites, totaling $35 million investment.<br><br>2 major transmit-receive stations in New York and Los Angeles, totaling $10 million investment, and video-distribution receive-only stations in numerous (probably less than 100) CATV market areas, each at about $0.1 million investment. |
| GTE | 4 major transmit-receive stations at Philadelphia, Los Angeles, Cincinnati, and Tampa, totaling about $26 million investment. |
| Network Carrier | 24, 36, 48, 72, or 96 transponders in 2 or 3 satellites, totaling $50 million to $140 million investment.<br><br>2 major transmit-receive stations in New York and Los Angeles, plus lesser transmit-receive stations in 27 other cities, plus receive-only stations in 122 other cities, perhaps totaling $100-$125 million investment, including terrestrial interconnections. |
| Leased-Line Carrier | May be same as network carrier or separate, depending upon network carrier's actions and capabilities in leased-line market.<br><br>24, 36, 48, 72, or 96 transponders in 2 or 3 satellites, totaling $50 million to $140 million investment.<br><br>Transmit-receive earth stations in at least 12 and perhaps more than 29 principal U.S. cities, totaling $15 million to $90 million. |

Source: Stanford Research Institute, "Economic Viability of the Proposed United States Communications Satellite System," (October 1971), p. 88.

accomplishments. There were three operational DOMSAT systems providing a wide range of services to domestic users: the WESTAR, SATCOM and COMSTAR systems. AT&T and GT&E were in the initial stage of providing satellite services within the message toll system, and significant price reductions were achieved by the satellite carriers that would prove to be substantially profitable for the satellite communications marketplace and the major communications users [97]. With the satellite technology firmly established and as the major firms moved towards the second generation of satellites, the emphasis was now placed on product identification (differentiation) and market segmentation of the various and unique products that could be offered by the satellite carriers. Some of the possible services were Alternate Voice Wideband Data, Alternate Voice-Video, On-Call Broadcast or Video Conferencing [98]. It became clear that a strong, aggressive marketing strategy was needed by the satellite carriers and the satellite equipment suppliers to remain as a viable contender in their competitive environment.

RCA with its SATCOM Program prided itself on the fact that its system was one of the most cost effective DOMSAT systems in the U.S. In the beginning, by choosing a new approach to system operation, leasing channel capacity vs. constructing their own satellites, RCA was the first to provide domestic satellite services for the U.S. To help reduce the cost of the space segment of their own satellite in 1975, RCA looked to a new approach that would provide high reliability, low

cost communications. Through an extensive and exhaustive project, RCA modified the launch vehicle and used a satellite that combined high capacity with low weight [99]. This matching of the spacecraft and launch vehicle was considered a significant cost advantage that represented a major step forward for commercial satellite ventures in the future.

The American Satellite Corporation took a strong lead in the industry by directing its efforts to serving government communications users. By aggressively seeking the government communications market, ASC took advantage of some of the primary advantages of satellite transmission, that is, the exceptionally wide bandwidth available in domestic satellites and the versatility of low cost transportable earth stations which can be moved to the customers' premises [100]. ASC's strategy called for the continuing expansion of both their commercial and government user networks as the function of the demand of the marketplace. It was hoped that with the cooperation of the terrestrial carriers, an ASC government user could also access locations served by the growing ASC commercial networks. It was because of the early development of their government network that the American Satellite Corporation concentrated on two general communications markets:

1. The common carrier communications market. This market is characterized by large, fixed earth stations which are connected via microwave routes to a major central office downtown in each of the served metropolitan areas served by ASC.

2. The second general market is characterized by the small transportable, dedicated earth stations such as those used by ASC's government networks. [101]

Thus the "Open Skies" Policy thrust the domestic satellite industry into its second stage. This stage lasted only several years until the initial DOMSAT systems were launched and operational. It was in Stage II where the challenge was met by companies to get in on the ground level of a new and better technology that would drastically improve the quality of communications. The introduction of competition into the DOMSAT industry in 1972 not only shifted the forces of influence in the external environment of the industry but widened the gap between the telecommunications and DOMSAT industry. The DOMSAT industry was now established as a fast growing but separate industry from the telecommunications industry. As it grew in the mid 1970's, the DOMSAT industry was becoming a vital part of the external environmental factors that impacted on the structure of the telecommunications industry. (See Figure 10.)

## C. STAGE III: MID 1970'S-1980's (Figure 17)

The mid to late 1970's saw even more dramatic changes in both the growth and technology of communications. New products in consumer-oriented equipment and technical innovations in transmission methods affected both the means and economics of communications. While the DOMSAT industry was off and running by 1976, the telecommunications industry was having its problems. As stated previously in Chapter III, the telecommunications industry's regulated monopolies, AT&T and GTE, were losing ground fast in their attempt to keep the industry

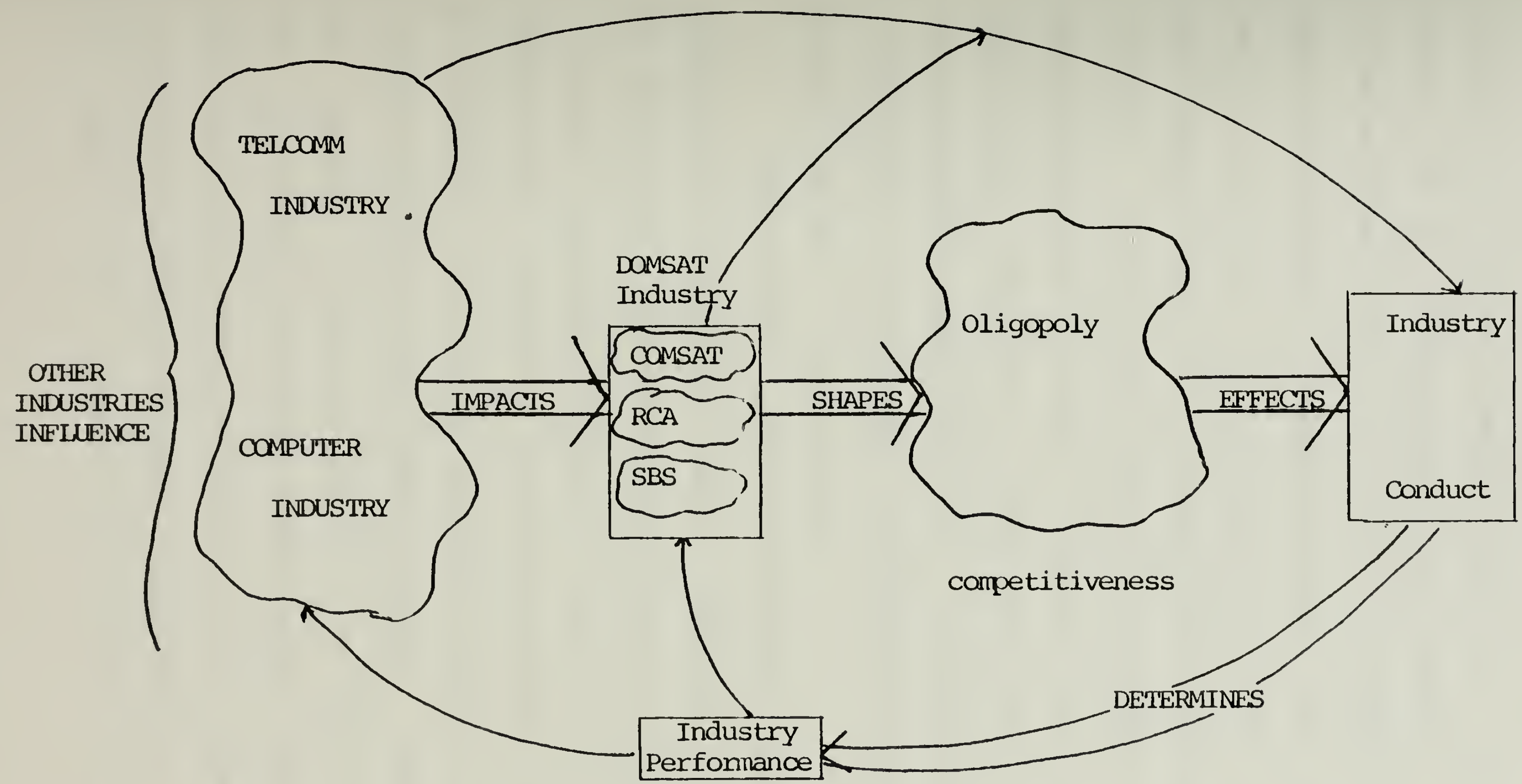



Figure 17. Domestic Satellite Industry Stage III: Mid 1970's-1980's

noncompetitive. Through the 1970's, the FCC's ruling in the Specialized Common Carrier Decision, the Domestic Satellite Decision, the Packet Communications Inc. Decision, Resale and Sharing and the Execunet Decision resulted in a rapid change of the external environment from noncompetitive to one of a competitive nature. Besides worrying about the effects of the FCC decisions, the telecommunications industry saw an even bigger threat to its monopolistic environment--the DOMSAT industry. In the third stage of the DOMSAT industry, the capabilities and functions offered by the various satellite corporations threatened to come into direct competition with the established common carriers. Services such as TV, radio broadcasting and telephone networks could now be provided through the use of satellites.

One specific area that competed directly with satellites concerned the submarine cables. Earlier in this chapter, it was stated that government regulations frequently intervene to prevent any major financial losses to the communication entities as a result of new communications technology. This is evident in the use of submarine cables over satellites for providing international communications. Submarine cables are still being laid despite the fact the cost per circuit is far lower with satellites than with cables. Cable proponents argue that the satellite delay time of a quarter of a second is serious enough to warrant continuation of the cable; and the added military security that comes from having more than

one transmission medium is another reason [102]. Therefore, lobbying takes place by both the satellite and submarine cable groups to ensure their vested interests. James Martin in his book Future Developments in Telecommunications, stated that one INTELSAT IVA satellite could handle all the traffic across the Atlantic, yet the FCC continues to authorize new trans-Atlantic cables of higher cost. The FCC then "insists that the public should be charged the same whether their call goes on the expensive cable circuit or the cheap satellite circuit" [103].

> Satellites could drop the cost of international calls to a small fraction of their present cost. With the large satellites ahead, this prospect is likely. However, if satellites are forced to compete with cable on a 50-50 basis, the user benefit will not materialize. [104]

While satellite communications were not advancing as rapidly on the international scene, the domestic satellite industry was making big strides on the home front. The same industry that had a major impact on the telecommunications industry's Stage IV had a similar impact on the DOMSAT industry's Stage III--the computer industry.

1. The Computer Industry Impact

The impact of the computer industry on satellite communications had its start back in the late 1960's. It was evident then that domestic satellites could solve a lot of problems and provide enormous service to the computer industry. Before addressing the computer and satellite relationship, it

is important to understand the development of the computer/ data processing industry relative to the telecommunications industry.

In 1966, the FCC in its Docket No. 16979, Regulatory and Policy Problems Presented by the Interdependence of Computer and Communication Services and Facilities initiated the Computer Inquiry to determine whether public computing services should be regulated. The questions posed by the Computer Inquiry

> and the subsequent responses and replies ranged from consideration of the current and future trends relating to the computer and information processing industry; to the adequacy of existing legislation to deal with such trends; to the need for new measures 'to protect the privacy and proprietary nature of data . . . transmitted over communications facilities . . .' [105]

There was a fine line drawn between communications and data processing and it would not be until 1973 that the categories would be defined with the termination of Computer Inquiry I. The following services involving computers and communications were defined:

1. Local data processing
2. Remote access data processing
3. Hybrid data processing
4. Hybrid communications
5. Message switching (and packet switching)
6. Pure telecommunications. [106]

Essentially, Computer Inquiry I prohibited major providers of communications services from offering data processing services.

Figure 18 shows the range of services defined by the FCC computer inquiry final decision.

From the conclusion of that inquiry the FCC would be constantly faced with many more issues that would inevitably result in the merger of the computer and communications industry. "Also, decreasing computation costs, in conjunction with the fact that voice telephone lines have only limited capacity to handle data, would make any superior alternative communications system, like a domestic satellite, a welcome addition in the computer world" [107].

In July 1974, the computer industry took a giant step forward to removing the boundary layer between the competitive computer industry and the regulated telecommunications industry via entry into the DOMSAT industry. IBM announced that it would form a subsidiary to buy the interests of Lockheed Aircraft Corp. and MCI Communications Corp. in a domestic communications satellite venture that the two companies had formed with the COMSAT Corporation [108]. It was envisioned that once formed, the new corporation would compete with telephone companies for long-distance data, graphic, and perhaps even voice communications traffic [109]. Satellite Business Systems (SBS) had been founded as a result of the FCC's decision regarding the proper role of both COMSAT and IBM in the domestic satellite area.

After MCI and Lockheed withdrew from the venture, COMSAT, COMSAT General and IBM filed a joint petition for the

Regulated by the FCC

Not regulated

A common carrier may not offer these services except through an affiliate which has separate facilities, officers, and accounting

| Pure communications | Message switching and packet switching | Hybrid communications | Hybrid data processing | Remote access data processing | Local data processing |
|---|---|---|---|---|---|
| Communications links which are transparent to the information transmitted | Computer-controlled transmission and possibly storage of messages where the meaning of the message is not altered | A hybrid service where data processing is incidental to message switching | | A data processing service where communications channels interconnect remote terminals to a central processor | A data processing service which does not use transmission |
| | | A "hybrid service" combines message (or packet) switching and remote-access data processing to form a single integrated service | | | |

Source: James Martin, Future Developments in Telecommunications (New Jersey: Prentice-Hall, Inc., 1977), p. 369.

Figure 18. Range of Services Defined by the FCC Computer Inquiry Final Decision

FCC's approval of changes in the CML (COMSAT, MCI, Lockheed) corporate structure. Under their proposed change, COMSAT General would acquire 45% and IBM would acquire 55% of the CML stock and voting control. In February 1975, the FCC issued a Memorandum Opinion and Order which disapproved the petition, but described three alternative circumstances under which applications for entry by COMSAT General and IBM would be considered [110]. The three alternative circumstances for application were:

1. Independent Entry Option

   IBM and COMSAT to enter independently of each other; COMSAT to have the option of joining another consortium.

2. Balanced CML Option

   COMSAT and IBM to merge but only with another partner(s), such that no participant would have greater than 49% or less than 10% stock ownership.

3. Lease Option

   COMSAT to provide IBM a space segment and to function only as a carrier's carrier, unable to offer common carrier services directly to the public. [111]

It was the "Balanced CML Option" that became the basis for the proposed structure of the present SBS partnership.

In accordance with the Commission's decision, SBS was formed with Aetna as the third party. In December of 1975, SBS filed application for a DOMSAT system and after a year of hearings, the FCC granted the SBS application in January 1977.

> The Commission found the proposed SBS services to be innovative and that further delay in the entry of SBS into domestic satellite communications would disserve

> the public interest. To the extent that potential anticompetitive concerns were raised by opponents, the Commission decided that the conditions it was imposing on SBS, together with its continuing regulatory powers, were sufficient to insure that no anticompetitive effects would occur from a joint entry by IBM and COMSAT. [112]

In the spring of 1977, the FCC expanded the computer inquiry into its second phase. Computer Inquiry II "sought to determine whether a definitive boundary could be established between communications services and equipment, which was regulated by the Commission, and data processing services and equipment, which were unregulated" [113]. With the increasing convergence of communications and data processing, the FCC saw a need for further clarification of the issues involved. The realization that computer activities were no longer confined to one physical location led the Commission to proposing a revised definition covering all data processing activities whether performed at one location or interconnected in a major communications network. The decision handed down in 1980 by the FCC in this inquiry basically stated:

1. A demarcation line should exist between "basic" communications (narrowly defined as "the capacity for the movement of information" or "pure transmission") and "enhanced" communications, which for all practical purposes includes all other communications.

2. AT&T and GT&E (because of their obvious size) be permitted to offer unregulated CPE (customer premise equipment) and "enhanced" services only through separate subsidiaries subject to a number of safeguards. [114]

The FCC in October 1980 finally freed AT&T from its regulatory constraints and placed the Bell System in direct

competition with the computer industry. This landmark decision will have a profound effect on the telecommunications and data communications service for the country in the years to come. This decision however, has met with immediate resistance most notably from the American Newspaper Publishers Association (ANPA). As of this writing ANPA plans to file suit challenging the FCC Computer Inquiry II Decision. The ANPA plans to use the 1956 Consent Decree, which keeps AT&T out of the unregulated services, as the basis for their appeal. However, AT&T is presently attempting to finalize a settlement in its 6 year old antitrust case with the Department of Justice which could change the 1956 Consent Decree. AT&T must conclude the negotiations and have a final settlement by March 2, 1981 or the case goes to trial March 4, 1981.

2. <u>DOMSAT Industry Performance</u>

The influence of the computer industry (and the telecommunications industry to a smaller extent) on the DOMSAT industry played a vital part in determining the satellite industry's performance in their present stage. The author pointed out earlier that two of the most important criteria for measuring the domestic satellite industry's performance were: 1) product performance and technological progress, and 2) technical efficiency. The growth of the computer industry as a result of its technological achievements and IBM's entry into the field of satellite communications contributed significantly to the "high marks" in the DOMSAT industry's performance.

Product performance was stated in Chapter III as "how well the firms engaged design, determine the quality of, vary, differentiate, and progressively improve their products--all relative to that performance in these several regards which would achieve the best attainable balance between buyer satisfaction and the cost of production." The early stages of the DOMSAT industry paralleled the telecommunications industry in that there were essentially no standards by which product performance could be measured. The pre-"Open Skies" Policy era of the industry consisted solely of the COMSAT Corporation, an organization that was established for the purpose of representing and promoting U.S. interests in a global communications satellite system. Since COMSAT was considered the primary reason for the "success" of INTELSAT, its effectiveness as an organization rather than its product performance could be a measure of industry performance in the first stage.

The introduction of competition in Stage II gave the firms an opportunity to demonstrate product performance and to make great strides in technological progress based on the creativity and innovation of each individual firm. However, the DOMSAT industry would have to receive "low marks" on product performance if indeed it can be measured at all in this stage because of one major consideration--cost. The firms in the industry in the early years were faced with an incredibly capital intensive product. Trying out new technological advances in a satellite system not only entailed high technical and

operational risk for the company but enormous financial risks as well. Many companies both large as well as small, were not willing to take these sorts of risks. Consequently product differentiation between the various satellite system were slight and technological progress moved forward in small incremental steps.

Although satellite costs have been constantly decreasing all through the years, it was not until Stage III with the influence of the computer industry technology (Mini and micro computers, computer chips, etc.) and the computer industry's utility of the satellite for data and information transfer that telecommunications services provided via satellite systems presented sufficiently attractive investment opportunities for many firms to enter the DOMSAT industry. The drop in cost has helped to establish balance between buyer satisfaction and cost of production. Also, with the satellite the cost of transferring a bit of information dropped significantly.

> While there will be a steadily moving decrease in the cost of land-based communications, the more interesting trend is for cost of domestic satellite-based transmission and for computer costs. These trends will have reduced the cost for moving a word or character or bit to almost nothing . . . by the end of this decade. And with the era of domestic satellites really just beginning, we can anticipate still further technological developments. [115]

With the introduction of digital data-transmission services via satellite, many corporations are setting up

nationwide data-communications networks with the intent of competing directly for the business dollar [116]. Many firms that offer satellite services are now very competitive and making rapid technological progress in the area of capabilities and functions they perform and the variety of services they provide. A customer interested in satellite systems must consider such things as: transmission, rate and speed of transmission, availability of access, switching functions, and other value added features [117]. An example of differences between satellite systems is illustrated by three satellite systems that will become operational in the near future: SBS, the Advanced WESTAR (Western Union Space Communications, Inc.) and AT&T's Scanning Beam satellite.

Table 8 shows a comparison of these three systems. Besides the above features, the following are other characteristics of the systems:

1. All three systems are intended primarily for long-distance capability for the private internal networks of very large organizations.

2. Among the participants, SBS is the only organization whose sole purpose is to provide domestic U.S. end-to-end private network capability. By selling transmission capabilities aboard its satellites, the new system would give each subscriber an independent communications network.

3. Two of the Advanced WESTAR satellites are intended for the exclusive use of NASA in connection with the space shuttle program and only one satellite will be available for commercial services.

4. AT&T's scanning-beam satellite system is considerably more advanced than either SBS or the Advanced WESTAR system but no commitment for commercial utilization has been made to date. [118]

TABLE 8

NEW SATELLITE DATA-COMMUNICATION SYSTEMS FOR PRIVATE NETWORKS IN THE U.S.

| | Satellite Business Systems | Advanced Westar | AT&T's Scanning Beam |
|---|---|---|---|
| Satellite technology | Fixed transponders | On-board switching of static, multiple-beams | On-board switching, scanning and static beams |
| Total digital satellite capacity, Mb/s | 430-480 | 1000 (Kuband) | 1200 |
| Frequency subbands in Ku band, MHz | $10 \times 43$ | $2 \times 225$ | $1 \times 500$ |
| Dual polarization | No | Yes | Yes |
| Total RF power from satellite, W | 230 | 111 (Ku band) | 300 |
| Ground antenna, diameter, m | 5,7 | 5,7,13 | 2.25 |
| Ground transmitter power, W | 500 | 300-1400 | 35 |
| Access control | Time division multiple accessing (TDMA) | TDMA | TDMA |
| Approximate number of earth stations planned for initial satellite | 375 | 100+ | 100-500 |
| Probable minimum ground-station cost | $480,000 | $350,000 | $100,000 |
| Present status | Under development, pre-operational service | Under development, form of marketing undefined | Discussion of concept |
| Estimated initial availability | 1981 | 1981-82 | 1983-84 |

Source: Gadi Kaplan, "Three Systems Defined," IEEE Spectrum (October 1979), p. 44.

An industry's market performance in the area of technical efficiency as discussed in Chapter II refers to "how closely it approaches (or how far it misses) the goal of supplying whatever output it produces at the minimum attainable unit of cost of production." Because of the regulatory environment of the DOMSAT industry, technical efficiency of the DOMSAT industry was difficult to measure. Again this is similar to the development in the telecommunications industry. As the industry became competitive, the firms had to find ways to maintain a high degree of technical efficiency to remain a viable competitor and maintain a reasonable profit margin. Technical efficiency therefore could be looked at from the standpoint of various trade-offs in satellite design depending on the goal or objective of the company.

The cost per channel per year is a measure of the efficiency of a satellite, thus the number of years a satellite will be operational is a satellite design consideration [119]. As Table II, Chapter IV reflects, the design life of the INTELSAT system increased from 1.5 years to 10 years over a span of 15 years. Although the design life of a satellite could be extended even further, say to 20 or 30 years, the rapid change in satellite technology today would make a satellite of that age very obsolete, uneconomical to operate and undoubtedly technically inefficient. Until technology levels off, a design life of 10 years is more than sufficient for today's satellite.

Technical efficiency of production is also influenced by the extent, if any, of excess capacity. In satellites, capacity translates into the number of transponders and channels. "The number of channels a satellite can provide is related to the bandwidth available and to how the bandwidth is used. The available bandwidth is related to the frequency allocation" [120]. Presently, satellites are operating in the 4/6 GHz (commercial) and 7/8 GHz (military) range which allows up to 500 MHz utilization of bandwidth. The higher the frequency that can be used, the more bandwidth that will be available for use. There are experiments being conducted in the 20-30 GHz range but the rain attenuation problem at these frequencies make them unsuitable for use at this time.

"The number of channels may also be increased by improving the efficiency with which a transponder is used" [121]. One of the critical aspects of increasing transponder efficiency lay in the development of the "sharing" techniques.

> A large common carrier can utilize an entire satellite for its traffic. To most non-common-carrier organizations satellite capacity is far in excess of their needs. Some organizations can use a whole transponder. To many, even one transponder has far too much capacity. The key to their using the satellite is techniques for sharing it. [122]

The sharing techniques have developed from a simple multiplexing scheme to a more complex multiple access scheme that is used in today's systems. A detailed technical description of each of the various sharing techniques is beyond the scope of this thesis. However, to show how the degree of

technical efficiency has increased in DOMSAT industry performance, the following is a brief description and/or definition of the various sharing techniques that have evolved over the years starting with the simple and progressing to the more complex [123].

1. Multiplexing
   A technique which permits more than one independent signal to share one physical facility. In a satellite a high level of multiplexing is needed so that many signals can share the bandwidth. There are three types of multiplexing:

   1) Space Division Multiplexing
      More than one physical transmission path are grouped together. A satellite's capacity can be shared by channels using the same frequency band and time if it has directional antennas.

   2) Frequency Division Multiplexing (FDM)
      Techniques for splitting up a single physical path by frequency slices. With FDM a guard band is needed between the frequencies used for separate channels. Generally associated with analog signals.

   3) Time Division Multiplexing (TDM)
      Technique for splitting up a single physical path by a time slice. With TDM a time is needed to separate the time slices. TDM is generally used with digitial signals.

2. Multiple Access
   In addition to simple multiplexing, this scheme will permit many geographically dispersed earth stations to share the satellite.

   a) Demand-assigned multiple access (DAMA)
      The capability to switch channels between multiple access points on a demand basis. When traffic fluctuates widely, fixed assignment of satellite channels to separate geographical locations will lead to inefficient utilization of the satellite capacity. The satellite is sufficiently costly that it is economic to use elaborate control equipment to achieve DAMA.

1) Frequency Division Multiple Access (FDMA)
   Makes available a pool of frequencies and assigns these on demand, to users. With FDMA, the transponder bandwidth is divided into smaller bandwidths. The first system for satellites to use this technique was called SPADE (Single-channel-per-carrier PCM multiple-Access Demand assignment Equipment). Designed for the INTELSAT IV satellite the goals of SPADE were:

   (1) To provide efficient service to light traffic links.

   (2) To handle overflow traffic from medium-capacity preassigned links.

   (3) To allow establishment of a communications link from any earth station to any other earth station within the same zone on demand.

   (4) To utilize satellite capacity efficiently by assigning circuits individually.

   (5) To make optimum use of existing earth-station equipment.

2) Time Division Multiple Access (TDMA)
   Makes available a stream of time slots and assigns these, on demand, to users. FDMA was used by satellites in the first half of the 1970's. In the future the cost of high speed digital equipment will drop and its reliability improved. Given appropriate cost and reliability, TDMA offers significant advantages over FDMA, giving higher satellite throughput and greater flexibility.

b) ALOHA channels
   A form of demand-assignment time division multiple access designed for interactive computer transmission. The ALOHA system is a system for interconnecting terminals and computers via satellites and terrestrial radio links. It provides a form of transmission discipline for interactive computing using broadcast channels. ALOHA techniques are attractive for future satellite systems if these permit large number of low-cost earth stations.

D. STAGE IV: 1980's-2000 (Figure 19)

The telecommunications industry is rapidly moving into a new stage where the socio-economical factors of our society again play an important part in its development. The DOMSAT industry is also moving into a new era, an era that parallels the telecommunications industry. Of course, the same factors from the external environment that impact the telecommunications industry are not lost on the DOMSAT industry. The increased social consciousness and social awareness and the introduction of satellites into everyday business will inevitably effect the future market structures of the computer, telecommunications and now the domestic satellite industry. The merger of the computer and telecommunications industry will be joined by the DOMSAT industry into the new Information Management Industry. Such phrases as "Home Information Concept," "Office of the Future," "switchboard in the sky," and "pocket-phone" are already becoming a part of our daily vocabulary. The Buck Rogers and Flash Gordon idealism of the 1930's and 1940's is a reality of today. The era of the "society at home" has evolved.

While the inflation rate of the last year has driven up the cost of living, i.e., food, housing, gas, etc., to an outrageous level, the cost of satellite services continue to decrease. This is a result of the decrease in the cost of manufacturing satellites and satellite parts. "Since it costs nearly as much to operate an empty satellite as one that is

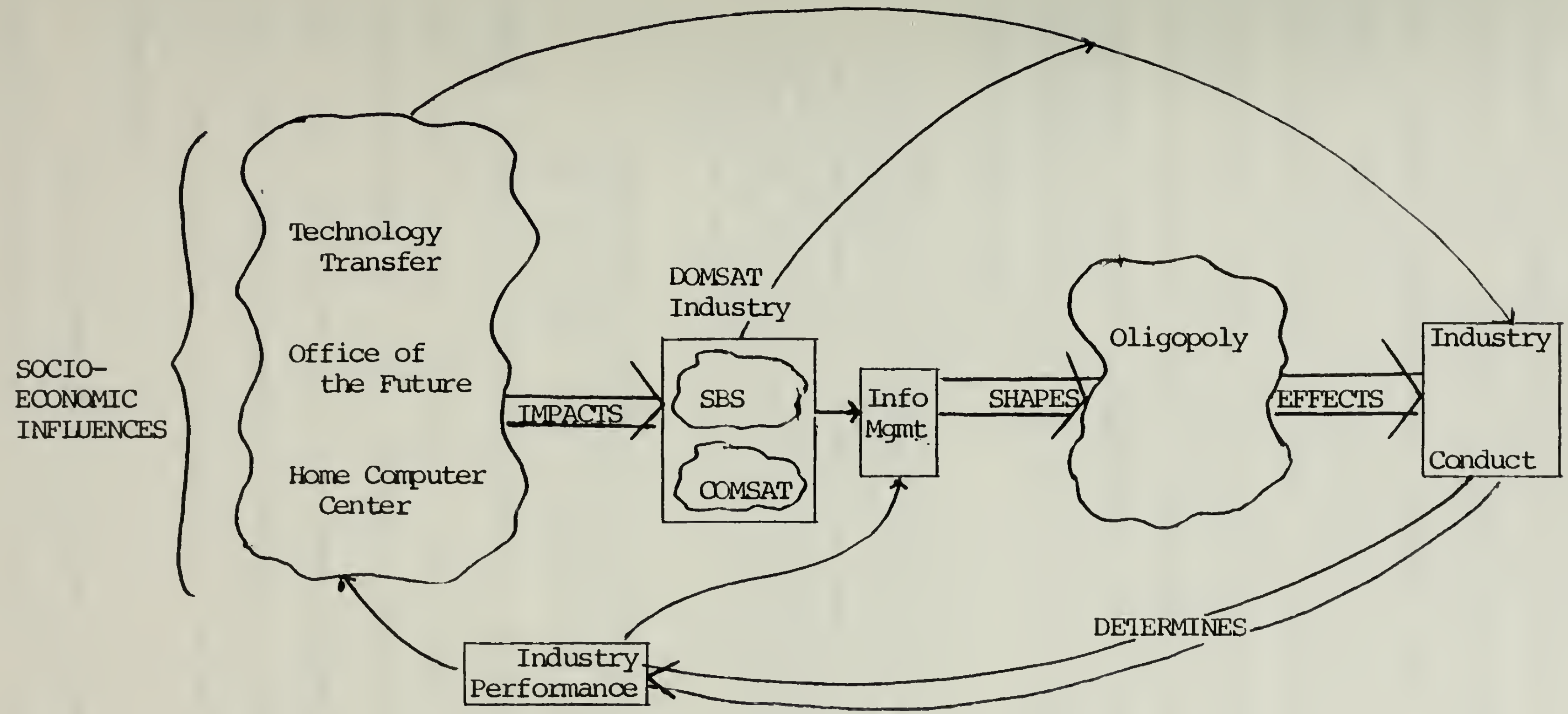



Figure 19. Domestic Satellite Industry Stage IV: 1980's-2000

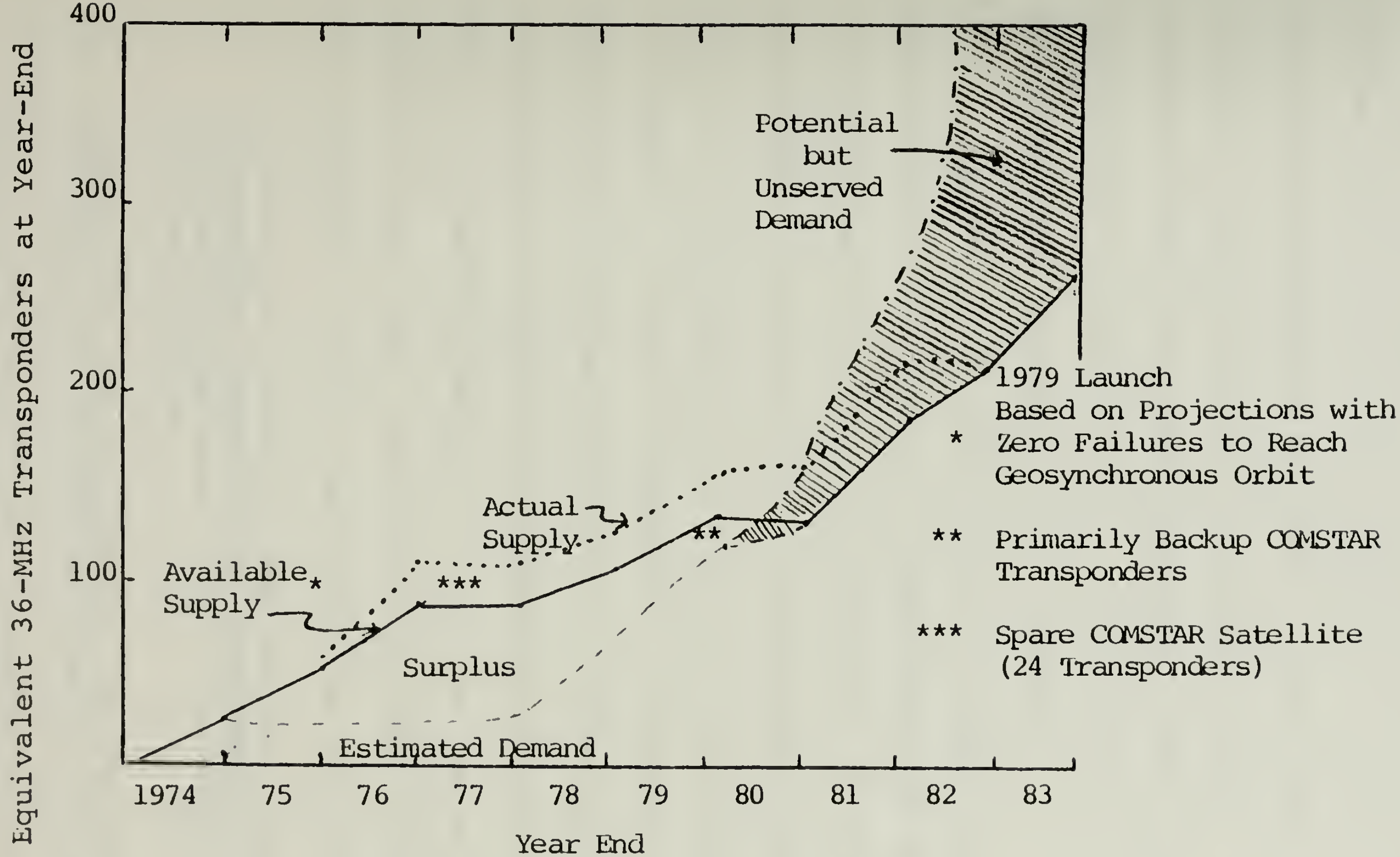
filled with traffic, incentives were offered to engender interest in leasing circuits, or better still, entire transponders" [124]. Figure 20 shows the supply and demand for U.S. domestic transponders at both the 4/6 GHz and 12/14 GHz range. Implicit in this figure is the assumption that prices will always continue to drop. The price of satellite usage may drop even further when digital services are used extensively throughout both the telecommunications and DOMSAT industry. Satellite communications is becoming more and more economical as businesses turn to its usage as a means of reducing other costs.

> Shortages of resources, particularly petroleum, will focus attention on the social cost of transportation. Eventually, there will be pressure to use teleconferencing to replace some air travel. In the more distant future, telecommuting (from the desk in the home to the national office via satellite communications) may replace the daily trip to work using the car or public transportation. [125]

### 1. Technology Transfer of Satellite Communications

One area that will become an integral part of the DOMSAT industry is the transfer of satellite technology to other areas of our society. Technology transfer of satellite communications to public service users is certainly not a new idea, but a concept that has been somewhat slow in putting into practice. The following discussion is about the evolution of technology transfer of satellite communications and its future direction.

The advancement of various technologies in many fields has been progressing at an incredible rate. So much so, that




Source: Walter L. Morgan, "Satellite Economics In The 1980's," <u>Satellite Communications</u> (January, 1980), p. 27.

Figure 20. SUPPLY VS DEMAND FOR U.S. SATELLITE TRANSPONDERS

the ability to adapt those technologies to practical or functional uses has become a serious problem. A concept that evolved from this problem is the management of "technology transfer." One definition of technology transfer is "the process by which existing research is transferred operationally into useful processes, products or programs that fulfill actual or potential public or private needs" [126]. The growth of satellite communications in the last two decades, dramatically illustrates how the application of new technology can benefit all segments of the society.

The National Aeronautics and Space Administration was established by the National Aeronautics and Space Act of 1958 to conduct research for the exploration of space in both manned and unmanned vehicles [127]. To undertake this mission, giant steps in technological and scientific achievement would have to be made. In the 1958 Space Act, Congress specifically tasked NASA with the obligation to "provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof" [128]. To accomplish this goal, the NASA Technology Utilization Program was initiated in 1962. The objectives of this program were:

1. Increase the return of the national investment in aerospace research and development by encouraging additional uses of the knowledge gained in those programs.

2. Shorten the time gap between the discovery of new knowledge and its effective use in the marketplace.

3. Aid the movement of new knowledge across industry, disciplinary and regional boundaries.

4. Contribute to the knowledge of better means of transferring new knowledge from its points of origin to its points of potential use. [129]

From the 1964 launch of the "Early Bird" satellite and through the 1960's, NASA took the lead in stimulating private industry research and development in the field of satellite communications through contracts, technical assistance and other coordination efforts. In 1973 however, the U.S. Government decided to abandon its leadership role in satellite communications research to pursue other technological endeavors. In the years that followed, the private industry's role in satellite communications R&D was modest at best. This was due largely to the fact that large monetary investments were required and the lack of a guarantee of success represented a significant risk to a commerical organization [130]. But as time and technology progressed, studies were conducted that showed that satellite communications provided a viable means of domestic communications. Consequently, several corporations filed license applications to the FCC for satellite system authorization. After much delay and legal and political red tape, the FCC authorized U.S. domestic satellites in the 1972 "Open Skies" Policy, and rapid development of U.S. domestic satellite systems took place.

The development of satellite communications in the U.S. was paralleled by development in other countries as well. Canada was the first country to establish a domestic synchronous-satellite communications system for the purpose of reaching into all areas of its scattered population. Other

countries such as Indonesia, Africa, Brazil, Saudia Arabia and many European nations have turned to satellite communications to solve some of their communications problems. With satellites well established as a media transmission for communications ranging from telephones to high speed data transfer for both commercial and military use, new frontiers are being examined for transfer of satellite communications technology to other areas of public service.

Over the last five years, there has been growing concern that the U.S. Government (NASA in particular) should revise its 1973 decision and resume its satellite communications R&D activities. The IEEE Board of Directors in 1977 was concerned that the present communications satellite technology was not being

> adequately applied to enhance the quality of life on earth. The U.S. Government should follow through in its R&D investment to assume the transfer of this technology to commercial use for public services including improved health service at lower cost, improved education, enhanced public safety, and better news and entertainment distribution. [131]

NASA's active role in this area was considered to be in the public interest because:

1. Private industry cannot economically fill the void left by U.S. Government abandonment of this role in 1973.

2. Programs of other governments have proliferated and show great promise.

3. Prior U.S. dominance in this technology is giving way to reduced participation in this vast market.

4. Prior technology is no longer being utilized to benefit the quality of life in the U.S. and among other societies of our planet.

5. Little technology is being developed. [132]

Over the last few years experiments have been conducted to explore the use of satellites in the area of health, education and other public services. It was discovered that a strong organizational structure, and a total awareness or indoctrination of the technology transfer process by those involved, was needed in order for this technology transfer to be successful. Mr. Witherspoon and Mr. Potter in their article "Making It Happen: The Feasibility of Satellite Communications for Public Service," talk of the "missing link" in the technology transfer process. The missing link in this process "is not lack of money but inadequate organizational mechanism . . . If use is to be made of telecommunications technology, it must be applied broadly and systematically" [133]. With a clear understanding of the problem and in an attempt to resolve some of those problems, the Public Service Satellite Consortium was established in 1975. This consortium consists of various consumer groups, educational institutions and medical organizations. The fundamental mission of this consortium is "to help its members render their respective services more effectively and at less cost. It will attempt to minimize the period of transition between completion of a successful experiment and the commencement of operational services" [134]. Acting as an interface between the

telecommunications industry (both commercial and private) and potential public service users, the Consortium hopes to direct and to accelerate the technology transfer process of satellite communications into various areas of public service. The strong potential use of satellite communications in public service is largely based on the economics of cost-savings. The rapid improvements of satellite communications capability coupled with the entrance of many corporations into the domestic satellite marketplace, has dramatically reduced the cost of these services so that they are now an economic viability for any institutions and organizations that could not afford them in the past.

In 1979 the 1973 NASA decision was reexamined and an assessment of its consequences on space technology R&D have resulted in a new commitment to resume NASA's space communication activities. The new program goals are:

1. To enable growth in the capacity and effective utilization of the finite and valuable resources--the radiofrequency spectrum.

2. To develop technology focused on enabling overall reduction in communication service costs.

3. To serve as a catalyst to the creation of the new and innovative services for the public good. [135]

One of the major areas of satellite technology transfer to public service users today is in health care and medical application. In Alaska, a group of health clinics was able to use the ATS-6 (NASA's Advanced Technology Satellite) system to assist in the treatment of remote village people--the

satellite linked the clinic with distant professional hospital staff [136]. A goal of Dr. Whitlock, Professor and Chairman, Department of Anatomy, University of Colorado Health Science Center is to bring the latest medical technology to as many rural communities as possible. "The economics of such a system would make top physicians available to communities that otherwise would never have the opportunity for such service" [137].

The medical profession is just one example where the application of satellite technology transfer can be utilized. In the field of education, the potential for satellite services seems unlimited from the video broadcasting of lectures and programs in the classrooms to the use of public television satellite systems in the home.

Among the various satellite systems now in development, the one that displays an impressive growth potential is the Direct Satellite Communication (DSC) system (now known as Direct Broadcast Satellite). This system is characterized by the use of small, inexpensive, earth station terminals--terminals that could be located on, or close to, the user's premises [138]. Because satellite communication costs are relatively independent of geographic distance, all commercial satellite systems potentially offer services that cannot be provided by terrestrial communication facilities within a realistic price. Because of the potentially inexpensive earth stations, DBS systems ought to be just as useful to the institutions of public service as they are for the individual.

The technology transfer of the early NASA space technology has opened up a new era in telecommunications and satellite communications that has unlimited potential for the public good. The progress of this technology in recent years has made possible national and even international participation in virtually any broadcast including academic lectures in many areas of study. With the ability to reach into every corner of the earth, the technology transfer of satellite communications has the potential to benefit everyone on the surface of this earth.

2. Direct Broadcast Satellites

In 1976, the FCC conducted what was reported as the first direct satellite-to-home T.V. receiver tests and demonstrated T.V. reception via CTS (Community Technology Satellite) to numerous individuals [139]. The introduction of Direct Broadcast Satellites (DBS) opens up a whole new arena of possible services that can be provided to the customer either on an individual basis or to a business firm for conducting day to day business. What DBS essentially consists of is the transmission of signals from earth to a satellite in geostationary orbit and the retransmission of those signals for reception by small, inexpensive receiving antennas installed at individual residences [140]. Considered in the area of video programming, DBS will be competing for the same market that is presently being served by other sources of video programming. Those services consist of:

1. CATV--Community Antenna T.V. (otherwise known as Cable T.V.). This system was originally designed to provide good signals to areas with poor over-the-air reception. Inexpensive satellite programs distribution have made available a wide variety of programming to CATV.

2. STV--Subscription T.V. Provides a scrambled over-the-air signal with a descrambler for use at subscriber's T.V. Programming is usually only offered during prime time.

3. MDS--Multipoint Distribution Service. A similar service to STV, MDS primarily serves hotels, apartment buildings, and other commercial establishments. Although not originally intended for home video delivery, this service is being purchased increasingly by individual households.

4. Video cassettes and video discs. Involves a video recorder or player attached to a regular television receiver set to operate on an unused channel. [141]

DBS essentially provides similar service and requires the additional equipment that is attached to the television. Also, like the other programming services, DBS will most likely require paying some sort of subscription fee.

The problem that providers of DBS will have to face is whether consumers will be willing to pay for the service and the cost of the equipment. Since DBS is essentially a close substitute for the other services, the success of DBS will depend on what value a potential customer will place on having this particular kind of service. If a customer is not willing to pay for the extra service of quality programming that is provided now, he/she will most likely not place added value or worth on having DBS services. Given the possible paths that DBS could follow relative to whether there is value

to the service or not, the structure of the DBS market faces two important regulatory implications.

> First, the more competition DBS faces from substitutes for its services, the more it will be constrained to provide the services the public wants at competitive prices and the less useful regulation will be in protecting the public interest.
>
> Second, the more competition DBS faces, the smaller its audiences and its revenues will be and the greater the burden will be of any regulation imposed by the FCC. With greater competition, regulation will be increasingly likely to raise the cost of a DBS service sufficiently to deter investment and prevent it from ever being initiated. [142]

The problem that is faced by the FCC today is to establish regulatory policies for DBS to ensure that it serves the public interest. Since the Commission is responsible for regulating industries that use the radiofrequency spectrum, three classifications of regulatory models have been defined to provide a model for DBS regulation: Broadcast, Common Carrier and Private Radio services [143]. Appendix A gives a description of those classifications and a proposed model for DBS.

On October 29, 1980 the FCC released a Notice of Inquiry, <u>In the Matter of Inquiry into the Development of Regulatory Policy in Regard to Direct Broadcast Satellite for the Period Following the 1983 Regional Administrative Radio Conference</u>. In the Inquiry, the Commission's aim was to pursue three goals:

1. Efficient use of the spectrum (including the balance between DBS and other services).

2. Opening new channels to allow an opportunity for diversity of voices in order to further the goals of the First Admendment.

3. Satisfaction of consumers' preference for programming.

The application of DBS opens up a pandora's box of issues and problems that must be resolved before full scale implementation can take place. The Notice of Inquiry issued by the FCC poses a variety of questions and issues that should be examined and commented on by interested parties before the FCC rules on the DBS issue. The following are some questions raised by the FCC on Direct Broadcast Satellites.

1. Will abundance of channels and competition among program sources make regulation of program content, types of service, and prices unnecessary?

2. Will DBS service institute a threat to any existing sources of programming? What will be the cost and benefits to the public?

3. Should the FCC set technical standards for DBS systems?

4. What should the liability of a DBS operator be with respect to the issue of copyright?

5. Relevant to the Communications Act, does it make any difference that programming services are provided to the public on a subscription rather than on a non-subscription basis?

6. If DBS operators were to offer direct-to-home programming services on a non-subscription basis, would there be any legal basis for distinguishing such services from "broadcasting" as defined in Section (o) of the Act?

7. Are there any legal consequences that flow from the differences between the definition of "broadcasting" in the Communications Act and the definition of the "broadcast satellite service" in the international radio regulations? [144]

Through the technology transfer of satellites to public service users and the introduction of DBS into our lives, it is clear that there will be drastic changes in our lifestyle in the near future. Our changing social values and emphasis towards the environment will mold and shape the DOMSAT industry or the Information Management Industry of the future to reflect the needs and wants of our society. The years ahead promise some wonderful and exciting new applications of advances made by the telecommunications, computer and domestic satellite industries. How far will we advance in this field by the year 2000? The inventions, devices that emerge from the new Information Management Industry that make our lives easier will only be hampered by our own creativity and imagination.

## VI. SUMMARY AND CONCLUSION

The telecommunications industry from its initial beginnings has shaped not only the courses of history but our society as well. As fast as telecommunications was progressing, the introduction of the satellite and its prominence as an industry in just a few short years staggers the imagination. If the telecommunications industry has gone through rapid changes in technology, the satellite's phenomenal rate of technical change has revolutionized our society, altered the patterns of finance, politics, business and last but not least, entertainment.

Based on the study of Industrial Organization theory, the author has presented a model of the domestic commercial satellite industry as well as the telecommunications industry with industry structure, conduct and performance as the underlying theme. The most critical aspect of the model, the driving force if you will, that sets the model in motion is the external environmental factors. To demonstrate that this is a dynamic instead of a static model of an industry, the author has taken the reader through the historical events of the telecommunications and domestic commercial satellite industry emphasizing the ever-changing factors of the environment that impact upon and change the industry. An interesting, perhaps even imaginative, collation was the cyclical pattern of predominant influential factors that effected the telecommunications

industry in its development. As a spin-off of the telecommunications industry, the DOMSAT industry has, so far, followed similar stages of growth. This is not surprising however, since both have their basis in the same technology and both have the same and ultimate objective--better and improved communications.

The introduction of the satellite launched the world into the space age. Caught off guard by the launching of the Soviet satellite, the U.S. raced to keep up with the Soviet scientific achievement. Thus driven by the possible change in the Soviet-U.S. relationship, the first stage was dominated by the political and regulatory influences of Congress and the FCC. The influence of NASA and the military on satellite development, the enactment of the Communications Satellite Act of 1962, the FCC docket concerning the establishment of domestic satellite service and other legislative and policy decisions during the 1960's gave the DOMSAT industry its structure. Because of the political and regulatory constraints, very little advancement took place in the industry towards development of a competitive, commercial satellite industry. Indeed, regulation seemed to have kept the industry in check.

When the winds finally changed towards creating a different environment for the industry, the 1972 "Open Skies" Policy launched the domestic satellite industry into its second stage. The competitive nature of the industry forced many new companies entering the field to review and change their strategy to

anticipate the future application of satellites to various ranges of consumers. The firms in the satellite industry had to keep on their toes in order to stay ahead of the competition if they had any designs of staying in the business at all.

By the mid 1970's, the DOMSAT industry was firmly planted as a viable and exciting new industry with much to offer. As a result the telecommunications industry (AT&T) now perceived the DOMSAT industry as a threat to their environment. While the telecommunications and DOMSAT industries were at odds with each other, the DOMSAT industry was getting help from another industry--the computer industry. The influences of computer technology helped to put satellite services within reach of many businesses and organizations that could not afford them in the past. Even as computer technology helped the DOMSAT industry, IBM looked to the satellite as a means of advancing its own future and getting a piece of the pie that for so long belonged to the telecommunications industry--data processing.

The end of the 1970's and the beginning of the 1980's saw the boundary layer between the telecommunications, computer and DOMSAT industries become muddled and almost undistinguishable. The changing social awareness in our country, the emphasis on conservation of our natural resources, getting back to nature, rights of privacy and the First Amendment, the Freedom of Information Act, etc., are all areas having a direct impact on the direction that the communications field will

take in the future. The merging of the computer, telecommunications and satellite industry into the Information (Processing) Management industry have some interesting ramifications for the near future. The advent of the home computer, electronic fund transfers, teleconferencing, computer tutoring of educational services, information of any kind available at the touch of a button, etc., is upon us. With these information processing techniques, the question that one must ask is, what will be the tradeoffs? In a book written years ago, George Orwell prophesized three fateful developments in our communication system of the future:

> First, technology would achieve the all-pervasive information environment.
>
> Second, words would be corrupted into blunt instruments of persuasion;
>
> finally, a mysterious controlling elite would exploit these developments for enslavement rather than for the enlightenment of man. [145]

It will be interesting to see what environmental factors and influences will affect the new information management industry. Perhaps socio-economic considerations or even the political environment will take hold and shape the new industry as suggested in the above quote. We may not have long to wait, after all, "1984" is just around the corner.

## APPENDIX A

## REGULATORY MODELS

### A. BROADCAST REGULATIONS:

1. Technical Standards.
   a. FCC applies more detailed technical standards to broadcasting than to any other category of services.
   b. Three objectives are maintained: spectrum management, ensuring compatibility of receiving and transmitting equipment, and ensuring a high quality signal.

2. Behavioral Regulations.
   a. Broadcasters transmit information intended for the public at large rather than for specific, known recipients.
   b. Broadcasters as public trustees are obligated to provide public service to the community.
   c. Broadcasters' public interest responsibilities require them primarily to provide kinds of programming that the Commission has determined to be important, as well as programming to serve the needs of the local community.
   d. The FCC sets quantitative guidelines for broader programming categories.
   e. Under the Fairness Doctrine, they must provide adequate coverage of public affairs and must provide an opportunity for expression of all points of view on issues they present.

3. Market Structure Regulations.
   a. Restrictions on ownership of multiple broadcast stations and on cross-ownership of broadcast stations by owners of other communications media. Restrictions apply at local, regional and national levels.

### B. COMMON CARRIER REGULATIONS:

Common carriers are firms that offer for-hire conduits for the transmission of information but have no influence over the content of the transmissions. Services are available, without discrimination, to all who are willing to pay the posted prices for such services.

1. Technical Regulations.
   a. Primarily intended to conserve spectrum, and to protect equipment (to prevent damage to the network), employees and customers.
   b. Determination of acceptable service is left to users.

2. Behavioral Regulations.
   a. Focus on how common carriers set prices and provide services to the public.
   b. The FCC does not apply content regulation since common carriers to not control message content.
   c. The FCC determines maximum allowed rate of return on the carrier's rate base.

3. Market Structure Rules.
   a. Common carrier regulation until quite recently implicitly assumed a monopolistic market structure.
   b. Common carriers are required to have separate subsidiaries in instances where carriers have desired to enter new markets.

C. PRIVATE RADIO REGULATIONS:

Private radio services include almost all users of the spectrum over which the Commission has jurisdiction that fit neither the broadcast nor the common carrier model.

1. Technical Regulations.
   a. Technical regulation of this service beyond allocation and assignment of frequencies is limited to interference control.
   b. The FCC regulates carrier frequency tolerance, authorized bandwidth, maximum power, and types of modulation.

2. Behavioral Rules.
   a. Strictures on impermissable communications.
   b. The FCC limits the ways in which various private radio users can share frequencies and equipment.
   c. Restrictions on how private service licensees may interconnect mobile units with the public land line telephone system.

3. Market Structure Rules.
   a. Regulations occur in only a few private radio services.
   b. Prohibition on ownership of more than one trunked land mobile system nationwide in the 800 MHz band by a single equipment manufacturer.

D. PROPOSED DBS MODEL:

1. Spectrum Allocation and Assignment.
   a. The FCC will have to allocate frequencies between DBS and other users in the broadcasting-satellite band and assign specific frequency bands to potential DBS operators.

2. Technical Regulations.
   a. The FCC will have to impose requirements preventing out-of-band emissions on DBS operators.
   b. To receive all DBS channels, receivers will have to be compatible with signal in respect to frequency, orbital location of satellite and waveform. The FCC must also decide whether the benefits to viewers and system operators outweigh the costs imposed.

3. Behavioral Regulations.
   a. The FCC should establish a more efficient method of choosing among mutually exclusive license applicants, preferably by auction, but if not by lottery or paper proceedings.
   b. The FCC will have to decide on the rules concerning program content.
   c. The FCC will have to address rules concerning prices or types of service offered.

4. Market Structure Rules.
   a. Regulation of prices and service offerings, or requiring operators to offer service to all on equal terms, would serve no useful purpose in a competitive market.
   b. Necessary limitations on concentration of ownership and control will depend on the ability of the consumers to choose another source of programming if one proves unsatisfactory, and thus are the alternatives available in the market.
   c. Since sources of information and opinion on issues of public affairs include newspapers, magazines, and radio broadcasting, the possibility of consumers being denied access to points of view they want to hear appears small. Thus, cross-ownership restrictions seem to offer few benefits.

Source: FCC. Staff Report on: Policies for Regulation of Direct Broadcast Satellites, Office of Plans and Policy. (September 1980), pp. 57-85.

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